Using Chinese Universities as a source of Technology Scouting

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Growth through Innovation and International Marketing

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Growth through Innovation and International Marketing
Abstract

Over the last few decades trends such as globalization have sharpened up competition on the worldwide open market and in order to meet customers demand high level of technological and competitive uncertainties have increased the pressure of reducing R&D budgets, reduce innovation cycles and shorter time to market as a consequence of the rising competition and as a result, forced companies to source external knowledge. One way of doing this is by tapping external information and knowledge from universities.

China is a country with a steady rapid growth on science and technology, but also with a progressively increasing R&D. Today they have the highest input level in the history and this is an opportunity for Western MNCs to establish collaborations in order to gain competitive advantages and create new technology. This study focuses on Industry-University collaborations in China for high technological companies and the process of finding knowledge and establishes networks at Chinese universities with the aim of establish Industry-University collaboration. Based on literature review and a qualitative study of Chinese universities, this thesis explores how a MNC can build a network of local universities connection in a fast growing market and use this network as a source of technology scouting.

Keywords: open innovation, external R&D, technology intelligence, I-U collaboration, Networks, Chinese Business culture.
Acknowledgements

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We would especially like to thank Lars Sickert at Tetra Pak Packaging Solution AB for support, guidance and input during this project. We would also like to thank the steering group at Tetra Pak; Helene Hartman, Ilka Dunder, Michel Sabouné and Cecilia Hertzman for giving us this opportunity.

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Finally, we are grateful to all our interviewees in China and for the information they provided us with that made this thesis possible.

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Meng Liu
<table>
<thead>
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<th>Description</th>
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<tr>
<td>BI</td>
<td>Business Intelligence</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>I-U</td>
<td>Industry-University</td>
</tr>
<tr>
<td>MNC</td>
<td>Multinational Corporation</td>
</tr>
<tr>
<td>OOR</td>
<td>Out of ranking</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>SOE</td>
<td>State owned enterprises</td>
</tr>
<tr>
<td>S&amp;T</td>
<td>Science and technology</td>
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<tr>
<td>TI</td>
<td>Technology Intelligence</td>
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1 Introduction
This chapter presents the research background followed by research questions. Purpose is presented and finalized with delimitations. Further, Case Company Tetra Pak Packaging Solutions AB are introduced and provides the reader with insight in the packaging industry.

1.1 Research background
Today companies do not only compete on their own market, the world is global and companies face an increased competition all over the world. Lichtenthaler (2003) argue that the globalizations of technology development of R&D resources have become globally integrated and that the learning ability of the basic organization has been improved, as international R&D sites are nowadays seen as tools of global technology and market learning.

When a company wants to advance their technology, Chesbrough (2006) claims that a firm should use both internal and external ideas and define this as open innovation:

“Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively”

(Chesbrough, 2006, p. xxiv)

Chesbrough (2003) states that irrelative innovation spillovers through external commercialization can be enabled by an active outflow. Teresko (2004) agree with this by holding that ideas can be spun-out from one organization and spun-in into another, where better complementarities can be offered and thus more likely to reach exploitation. One example of this is Procter and Gamble that have succeeded by innovating innovation through internal and external collaborations and hence increased their efficiency of its R&D investments. According to Chesbrough (2003b) Open innovation makes it possible to advance the development of new technologies by active search for new ideas and technology outside the company, but also through collaboration with suppliers, universities, end-users and competitors to create customer value.
Open innovation has according to Billington and Davidson (2010) over the past decade begun changing the way companies develop new products, as the benefits of exposing internal R&D to outside ideas is recognized by executives. In times of rapidly changing technology it is time to look outside the gates in order to develop faster and better solutions to different problems.

With the fast progress of technological changes Lang and Mueller (2010) state that all business sectors are affected and that this progress comes with threats, but also with new opportunities. In order to identify technological development in time, they point out that strategic planning including technology intelligence is crucial. To enhance their competitive position Land and Mueller (2010) and Rohrbeck (2007) describe Technology Intelligence as identification of a need. Due to the globalization of R&D that have increased the complexity of technology, Rohrbeck (2007) stresses that it has become more difficult to develop technological competences internally,

According to Gray and Meister (2004) companies are as a consequence exploring new ways of sourcing technological capabilities externally. One way of doing this is according to Rohrbeck (2007) Technology scouting that has the ability to detect advances in technology at an early stage.

“*The goal of Technology Scouting is to gain a competitive advantage by identifying opportunities and threats arising from technological developments at an early stage and to provide the technological capabilities needed to face these challenges*”.

(Rohrbeck, 2007:p. 5)

Lang and Mueller (2010) and Mortar et al. (2009) hold that informal information is gathered from primary or secondary experts and Rohrbeck (2007) emphasizes that it is the personal contact established by the scouts for information gathering purposes that is the base for sourcing technology. Moreover, Lang and Mueller (2010) and Mortar et al. (2009) explain formal information as publications that have a slower reaction to the technological changes, due to the lead time between innovation and publication. However, they hold that this kind of sources is easier to access than
informal sources. Technology sourcing is important for companies in order to stay competitive on the global market.

Fritsch and Kaufeld- Monz (2010) strengthen by Nonaka et al. (2000) say that innovation and long run survival require access to external knowledge. Integration into innovation networks can according to Fritsch (2001) help companies to obtain tacit knowledge that require certain capabilities in order to be absorbed. Cowan et al (2000) state that partners in an innovative network often tend to have closely related interests and that is why the chances of gaining valuable information and knowledge are perceived as high. Furthermore, Uzzi (1996) found that joint problem-solving may help the network members to create new solutions and new mixtures of ideas. Most important is that networks provides with access to valuable knowledge and information hold Malmberg and Maskell (2002) that Fritsch and Kaufeld- Monz (2010) claim strengthen a company’s ability to be innovative.

Harryson et al. (2008) suggest I-U collaborations as fruitful way of finding and developing new technologies and see it as a critical form of learning alliance and a critical instrument to gain both speed and flexibility in technology innovation and at the same time reducing costs in R&D. Collaborations and joint ventures help a company to extend their networks and it is also a way of finding competent recruits to the company, with knowledge within a specific area.

1.1.1 China as a source of technology intelligence
New technologies and innovations are arising from new technology clusters in emerging markets as a result of globalization state China stock digest (2010). Economic powers are transferring from developed to emerging markets and at the same time the western world struggling with economic decline. Germany that is one of Europe’s leading economic power had in the first quarter of 2008 a GDP growth of 4, 5 % while China had a rate above 10 %. According to Economy Watch (2010), China is the second largest economy in the world with a GDP of totaled $7.8 trillion.

Chinese institution of higher education is according to Adams et al. (2009) “powerful for knowledge development, exploitation and innovation” as they have more than 25
million students of higher education. They show an tremendous increase of Chinese publications and in 1998 China produced 20 000 papers and the output increased to 112 000 papers by 2008. China surpassed Japan, UK and Germany in 2006 and is right after The United States of America according to Adams et al. (2009)

![Annual publications in Web of Science](image)

Figure 1: Annual publications in Web of Science
Source: (Adams et al., 2009)

China has in a recent five-year period produced 400 000 papers in all fields of science which is approximately 8, 5% of the world´s papers published in journals. The concentration is according to Adams et al. (2009) within physical science and technology with Material Science, Chemistry and Physics predominant. They highlight that this is China´s traditional core strength rooted in an economy of heavy industry and primary manufacturing. This relative level of investment in materials and related physical science will provide China with a strong innovation platform in modernizing those industries.
Table 1: China’s share of world publications in selected main fields

<table>
<thead>
<tr>
<th>Field</th>
<th>1999-2003</th>
<th>2004-2008</th>
<th>Rank</th>
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<tr>
<td></td>
<td>Count</td>
<td>Share(%)</td>
<td>Count</td>
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<tr>
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<tr>
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<td>4.54</td>
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<td>Geosciences</td>
<td>5,322</td>
<td>4.95</td>
<td>12,673</td>
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<tr>
<td>Pharmacology &amp; Toxicology</td>
<td>2,259</td>
<td>3.11</td>
<td>6,614</td>
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<td>Environment/Ecology</td>
<td>3,171</td>
<td>3.26</td>
<td>9,032</td>
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<tr>
<td>Space Science</td>
<td>2,055</td>
<td>3.80</td>
<td>3,514</td>
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<tr>
<td>Biology &amp; Biochemistry</td>
<td>6,697</td>
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<td>15,971</td>
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<tr>
<td>Plant &amp; Animal Science</td>
<td>5,915</td>
<td>2.61</td>
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<td>Agricultural Sciences</td>
<td>1,082</td>
<td>1.48</td>
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<td>1,642</td>
<td>1.43</td>
<td>6,210</td>
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<tr>
<td>Immunology</td>
<td>493</td>
<td>0.87</td>
<td>2,114</td>
</tr>
</tbody>
</table>

Table 1: China’s share of world publications in selected main fields

Source: (Adams et al., 2009)

1.2 Problem definition

The time is changing and the world has become a global market where companies are competing to survive. China is a country with a steady rapid growth on S&T, but also R&D are increasing progressively and has today the highest input level in the history according to Xorute (2009). This can be seen as a threat since this enables Chinese companies within the packaging industry to move very fast and to compete on the global market, but it is also an opportunity for companies to collaborate with universities in order to gain competitive advantages and create new technology. China is according to Jansson et al. (2007) and Harryson et al. (2008) a hierarchical country where the networks have very strong ties, since they are based on family and
are spread very wide which has resulted in massive networks. To be able to collaborate and become a part of technology networks in China, insight in the system is needed state Von Zedtwitz (2004) and thus, the following research questions have been developed.

**Main research question**

How can Chinese Universities serve as a source of technology scouting in China?

**Sub question 1**

What universities do Western and Chinese companies use in China to Gain Technology Intelligence?

**Sub question 2**

How do Chinese and Western companies interact with universities in China to Gain Technology Intelligence?

**Sub question 3**

How can Western MNCs establish and maintain networks to Chinese universities to get access to new technology that is originating from the universities?

1.2.1 Purpose

The purpose is to explore how a MNC can build a network of local universities connection in a fast growing market and use this network as a source of technology scouting.

1.2.2 Delimitations

We are only focusing on University Collaborations in China within the area of technology. We have only looked into top 40 ranked engineering universities and focus on high ranked universities in our study, due to Tetra Pak´s requirements. We will also focus on Chinese university collaborations with Western MNCs because of differences in Western and Chinese business culture because of interest for Tetra Pak.
We have looked deeper into literature on Industry-University collaborations and have found that they only discuss the internalization process, which is not the purpose with this thesis, which is why the section about the subject is small.

1.3 Packaging Industry
Almost 90% of products consumed by packaging are according to Jenkins (2009) for food and more than one-third of this market is within liquid packaging. A growing trend is seen in the packaging industry in recent years toward the usage of plastics, which in turn has affected sales of metals, glass, paper and board packaging.

The environmental concerns are taking place in the whole value chain from brand owners, retailers to customers state Jenkins (2009). This have an impact in numbers of key areas and has resulted in a growing interest in bio-based products sourced from renewable resources and the demand for materials that is biodegradable and have properties protecting from oxygen and water have become very attractive. Furthermore, he appoints that another drive factor is that companies want to reduce costs and finding new materials can help them with this. He has determined that the growing concern for the environment has resulted in opportunities and challenges to all parts of the industry, but paper and board packaging is well positioned to withstand these pressures and can indeed benefit from them.

However, the changes in the economy due to the financial crisis and the opening up of the Chinese market affect the opportunities available. Depending on the financial crisis the market growth rate have slowed down holds Jenkins (2009), but the Asian market represent only 24% of the global market is expecting growth of 7%, mostly in China. The total packaging market grew between 2002 and 2007 7, 8% and was in China valued at $46 billion.

The development and open up of Asia’s economy has according to Jenkins (2009) created growing opportunities for suppliers of packaging and functional and barrier coatings. In China this market has experienced growth of 20% or higher and also the increasing consumption of dairy products is creating huge opportunities for liquid packaging board and its functional and barrier coatings.
Jenkins (2009) stresses that technology such as Nano technology and plasma has very few commercialized products on the market, but development work continues which indicate that there is improved performance of functional and barrier coatings. Potential for high-performance barriers from extremely low application levels is possible and the industry is eager for coming results.

1.4 Case company Tetra Pak Packaging Solutions AB

Tetra Pak is a part of Tetra Laval Group, a private Swedish industrial group placed in Switzerland. Tetra Pak, DeLaval and Sidel are three independent organizations, but can cooperate if there is an advantage and cover together almost the whole area of processing, packaging and distribution of all variant of food (Tetra Pak, 2010).

Tetra Pak provide their customers with packaging solutions and processing solutions and develop and produce systems for usage and packaging of beverages. It supplies hundreds of different types of carton packaging formats and they have their biggest development- and production unit in Lund that comprises R&D, manufacturing of process equipment and packaging lines (Tetra Pak, 2010).

1.4.1 Scope

Tetra Pak needs to keep up with the technological development. China is today the largest producer of engineering graduates in the world state Engineering in China (2010). This is one of the reasons why Tetra Pak are looking into Technology Scouting in China, since the Chinese universities appears to be a possible fruitful way of finding new technology and thus a source of Technology Intelligence.

The scope for this thesis is to identify technological areas and networks that are or will become critical for Tetra Pak. In order to do this we are going to China to identify accessible and relevant sources and networks for technology scouting. The technological areas we are scouting for is polymer in the context of barriers and adhesion with paperboards.
1.5 Thesis outline

<table>
<thead>
<tr>
<th>1 Introduction</th>
<th>2 Methodology</th>
<th>3 Theoretical framework</th>
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<tbody>
<tr>
<td>-&gt; Research background</td>
<td>-&gt; Research strategy</td>
<td>-&gt; Open Innovation</td>
</tr>
<tr>
<td>-&gt; Main research question: How can Chinese Universities serve as a source of technology scouting in China?</td>
<td>-&gt; Scientific research approach</td>
<td>-&gt; Growth of outsourced R&amp;D</td>
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<td>-&gt; Purpose and Delimitations</td>
<td>-&gt; Research method</td>
<td>-&gt; I-U Collaboration in China</td>
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<td>-&gt; Case company and industry</td>
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<td></td>
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<td>-&gt; Networks</td>
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<td>-&gt; Chinese Business environment</td>
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<th>4 Empirical findings</th>
<th>5 Analysis</th>
<th>6 Conclusions and recommendations</th>
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<tbody>
<tr>
<td>-&gt; Relationships and networks</td>
<td>-&gt; Chinese university networks</td>
<td>-&gt; What universities do Western and Chinese companies use in China to Gain Technology Intelligence?</td>
</tr>
<tr>
<td>-&gt; Industry collaboration</td>
<td>-&gt; Relationship building</td>
<td>-&gt; How do Chinese and Western companies interact with universities in China to Gain Technology Intelligence?</td>
</tr>
<tr>
<td>-&gt; Adaptation to the industry</td>
<td>-&gt; I-U Collaborations</td>
<td>-&gt; How can Western MNCs establish and maintain networks to Chinese universities to get access to new technology that is originating from the universities?</td>
</tr>
<tr>
<td>-&gt; Collaboration with Western companies</td>
<td>-&gt; Using Chinese universities as a source of technology scouting</td>
<td>-&gt; How can Chinese Universities serve as a source of technology scouting in China?</td>
</tr>
<tr>
<td>-&gt;Using Chinese universities as a source of technology scouting</td>
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<td>-&gt; Determinant factors for collaboration</td>
<td>-&gt; Company support</td>
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<td>-&gt; Company support</td>
<td>-&gt; Horizontal and Vertical projects</td>
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<td>-&gt; Horizontal and Vertical projects</td>
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</tbody>
</table>
2 Methodology

In this chapter we present the applied methodology in this thesis. We first describe the scientific research approach followed by the research method. Furthermore, the abductive approach is described, where we outline how theory and empirical findings are combined in the thesis. To accomplish the research, we present the chosen strategy and the case study design. An overview of needed data collection is given and this chapter is ending with a discussion of the quality of the research.

2.1 Research Strategy

It is important to choose the right strategy when doing research according to Yin (2003) since the strategy defines the direction and process required to reach a specific goal. He finds that the choice of the research strategy depends on three conditions:

1. The type of research question
2. The extent of an investigator’s control over the actual events
3. Whether the focus of the analysis is on contemporary or history events

According to Yin (2003) there are also five different types of research strategies; experiment, survey, archival analysis, history and case study. Table 1 show these three conditions and how each one is related to the five major research strategies.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Form of research question</th>
<th>Requires control over behavioral events?</th>
<th>Focuses on contemporary events?</th>
</tr>
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<tbody>
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<td>How, Why?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Survey</td>
<td>Who, What, Where, How,many,how much?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Archival analysis</td>
<td>Who, What, Where, How,many,how much?</td>
<td>No</td>
<td>Yes/no</td>
</tr>
<tr>
<td>History</td>
<td>How, Why?</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Case Study</td>
<td>How, Why?</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 2: Relevant Situations for Different Research Strategies
Source: (Yin, 2003)
The process using universities as a source for new technology is complex and are best understood by asking how questions. This study focuses on contemporary events and thus, do not require control over behavioral events and therefore a case study approach is the most suitable strategy to use. We do not have any control over these phenomena, and strengthen the decision of conducting a case study.

For research questions starting with “why” and “how” Yin (2003) finds the qualitative approach is the most suitable and also when the researcher has little control over events. For investigation of a contemporary phenomenon within its real-life context a qualitative research provides a sound tool for a case study according to him. He also states that it is useful when the context not is clearly evident and fit research where multiple sources are used. It is not possible to answer our research questions in a quantitative approach since our research questions start with “how”. Moreover, the objective of this thesis is to create a deeper understanding in the area of the specific case, but also to develop useful theory. We do this by doing face-to-face interviews with professors and PhD Students at Chinese universities.

According to Yin (2003) a case study can be based on single- or multiple case studies.

Table 3: Types of case study designs
Source: (Yin, 2003)

Yin (2003) describes the research design as the logic that links the collected data to the initial research questions. He classifies four different types of case study designs, see Fig. 1 and he uses the distinction between single – and multiple cases divided to four different designs. A single case study is comparable with a single experiment and therefore relevant when analyzing only one case and multiple cases including two or more cases within the same study. Furthermore, a case study can be divided
into embedded and holistic and according to Scholz and Tietje (2002) the analysis in an embedded case study is either concerned with more than one unit or aspects with different perspectives or inquiry. Yin (2003) points out that the holistic case study examines the global nature of an organization, while the embedded case study examines one or more subunits within the unit of analysis. Scholz and Tietje (2002) describe a unit as a department in the case company or a process taking place within the organization. According to them the sample units are primary data sources that are considered to best answering the research questions.

Since the objective for this thesis is to investigate external units outside the case company, namely high ranked Chinese Universities, thus a holistic single case study research design is found as most suitable for the given case.

2.1 Scientific Research Approach
For conducting research three different approaches are found: The descriptive, the exploratory and the explanatory state Yin (2003). According to Scholz and Tietje (2002) the exploratory approach is most suitable when developing models, hypotheses or theories, which is strengthened by Yin (2003). The authors hold that this approach is used when there exist no or only a small amount of information about the research phenomenon, but also when the purpose is to generate interesting questions to be analyzed later. The explorative approach is found useful as a pre-analysis of what should be examined in a later stage. To get a closer insight into theories concerning the thesis we use an exploratory approach in the initial stage of the thesis to identify, define and structure the problem. By studying related theoretical topics and doing interviews in China related to the subject, the exploratory approach is mainly used.

The descriptive approach presents according to Yin (2003) a complete description of a phenomenon within its context and the aim to describe an event that previously has been explored with a model or a theory reference. This approach has been applied in the analysis based on the theoretical framework and the empirical study of field studies and interviews, since there is existing theory available tested on a similar case study.
Yin (2003) and Scholz and Tietje (2002) describe an explanatory case study as data bearing on cause-effect relationships, explaining how events happened. This approach has been exploited after the collection of data in order to explain the connection between different factors from the empirical findings and theoretical framework. The explanatory approach is used when we explain how the theory and empirical findings are interlinked and what it has resulted in. This is presented in the final part of the thesis where the analysis of the results and conclusions are presented.

According to Dubois and Gadde (2002) researcher can use different ways of scientific reasoning, which can be defined as inductive-, deductive- or abductive approach. Fisher (2004) stresses that conclusions drawn from already existing theories and principles has a deductive approach. Moreover, Bryman and Bell (2005) point out that deduction consists of some extent of previous knowledge to the subject and have appreciation in the relevant theory.

When explaining a specific case or event based on theory Dubois and Gadde (2002) state that the deductive approach is used. According to Patel and Davidson (2003) the objectivity is strengthen by the deductive approach of the research, since already existing theory is used as a starting point for the research. However, they claim that this approach can delimit new discoveries by influence and direct the researcher toward a specific direction. On the other hand, the researcher without any previous knowledge is using an inductive approach hold Bryman and Bell (2005). It is according to them complicated to analyze the subject since the methodology in the beginning is based on the empirical findings.

Another approach is to combine induction and deduction, which is the abductive approach according to Dubios and Gadde (2002). They stress that it is an incessant movement between an empirical fieldwork and theoretical framework and a case study, which they call a “Systematic combining”. Harryson (2002) find the overall benefit from this approach that the theoretical and empirical analysis is continuously evolve simultaneously with the research process.
The deductive approach is used while we are working on the theoretical framework and also when making conclusions. Meanwhile, working with what is new to the study, mainly the analysis; the inductive approach is used, which means that we are conducting an abductive approach.

2.2 Research Method

A case study research can either be quantitative or qualitative, and according to Merriam (1998), the ways of collecting and analyzing data are affected by the choice of research methodology. According to Andersen (2005), the quantitative method includes systematic reviews, surveys, and is striving towards predicting events and phenomenon based on determined patterns. Furthermore, Merriam (1998) holds that the explanation of the phenomena’s nature is the focus for a qualitative research rather than predicting what might happen in the future. If there is a lack of theory or the existing theory fails to explain a phenomenon adequately, Merriam (1998) states that a qualitative research is undertaken. Furthermore, she emphasizes that the qualitative research is flexible and responsive to changes of the conditions in the progress of the study.

To achieve a deeper understanding of a subject, Andersen (1998) suggests a qualitative research methodology. It is an open-ended study that opens up for the opportunity to discover unpredicted areas, states Holliday (2002). When the research is searching for answers to understand and gain insight in individual measurements and evaluations, Andersen (2005) finds the qualitative research useful. According to Fisher (2004), the qualitative research includes interviews, observation, and document analysis, and Merriam (1998) adds that the sampling is limited and includes a few selected interviews or observations. These tools are considered as very useful in this thesis and case study.

2.3 Data Collection

Yin (2003) describes six different sources of data collection: documentation, archival records, interviews, direct observations, participant observation, and physical artifacts. Furthermore, he states that these sources are working complementary and
therefore it is good to use as many as possible, which also Merriam (1998) agree with and hold that using more sources will give a deeper understanding of the case study.

This thesis is based on documentation and interviews as main source of evidence, but also information from a workshop with experienced executives within, our research area. According to Yin (2003) documentation is valid for its stability, exact data and a extensive coverage. However, the weakness of using this data as a source is its accessibility and therefore interviews are also used. He states that this makes it possible to focus on the research topic directly and provide with information. This source of data can be biased of poorly constructed interview questions or incorrect summon up of the given information. Furthermore, he finds that the method is used when studying new technologies in order to gain understanding and the potential problems.

Yin (2003) describes Use of multiple Sources of evidence in order to be more credible and accurate. By using various data sources, he stress that data triangulation is created which in turn can lead to more convincing and correct findings and conclusions in a case study. We have for our research used many different sources of evidence and collected data sources from Chinese universities, but also participated in an executive seminar and in that way get perspectives from both directions and different point of views. This has helped us to develop more convincing and correct findings and conclusions in our case study.

Another principle is to create a Case study database and according to Yin (2003) a database increases the reliability of the whole study. This has to do with the way of organizing and documenting the collected data and we have organized and categorized the data to make it easy to access again if needed.

To strengthen the validity of this case study, both primary and secondary data is used.
2.3.1 Selection of Primary Data

It is according to Merriam (1998) important to consider whom, what, when and where to do the observations. She has determined different types of samplings and we will further explain those types we have used in our case study.

Unique sampling is based on rare attributes or occurrences of the research interest stress Merriam (1998) and we have selected our respondents by evaluation of different criteria based on the interest of the case company Tetra Pak.

Another type is called snowballing and is based on respondents’ referrals to other contributors that might have knowledge about the research topic. This method have been very useful for us since many of our interviews is based on recommendations from others and has also worked as a door opener into other university networks that are very closed outside the universities world. This process is according to Merriam (1998) cost-efficient and simple in comparison to other sampling techniques, since it takes less time and planning. An advantage for our case study is that we want to reach a subgroup of professors. In this way we have reached more persons and gained more information from different sources.

Since it is very hard to get into Chinese university networks we have also used convenience sampling in order to use them as door openers as well as sources of information. According to Merriam (1998) this selection is based on money, time, location and availability. The biggest disadvantage of using this method is lack of credibility. Since we have fund limits due to our China excursion and also lack of time, this was used in order to get answers on more general questions, which has gain us understanding for our study.

**Interview persons**

Professor Su Zhiqiang is working at Beijing University of Chemical Technology in the College of Materials Science and Engineering. He is director of Key Laboratory of Beijing City on Preparation and Processing of Novel Polymer materials. Cao Tingbing is professor at Remini University of China in Beijing and work for the Department of Chemistry and is also a post Doctor of Harvard University. Professor Kang Sun is Director of Institute of Biomaterials and work in Shanghai Jiao Tong
University in the School of Materials Science and Engineering. He is also Deputy Director of Institute of Composite Materials and State Key Lab of Metal Matrix Composites. Yinfeng Liu, Ruofeng Wu and Hefeng Hu are professors at Shanghai University in the Department of Polymer Material. Xuming Xie is professor at Tsinghua University in Beijing at the Department of Chemical Engineering.

2.3.2 Primary Data Collection

According to Merriam (1998) primary data is mostly collected through interviews and observations. Denzin and Lincoln (2000) define interviews as the most prevailing and common ways that gives understanding. Interviews make it possible for the researchers to ask questions that will give exact answers to the research area stress Merriam (1998) and also that impression of environment, body language and other factors can be taken into account. This can also provide understanding and help the interviewer to read between the lines and to understand the context of the answers. The disadvantages of conducting interviews are the time, since it takes time to conduct the interview, but also to transcript and analyzing it. However, this is related to the outcome of the interviews. The primary data for this case study was collected through several personal interviews with universities and companies.

Denzin and Lincoln (2000) points out that an interview can be differentiated between structured, unstructured and semi-structured interview. In a structured interview the same questions are asked, but according to them only a limited set of response options can then be determined. Unstructured interviews provide an unlimited set of questions and answer possibilities. Goulding (2005) and also Bryman and Bell (2005) points out that semi-structured interview generate detailed and fruitful information because it is flexible enough to allow discussions and the freedom to move away from those and instead ask other deepening questions based on answers or other given information. Klandermans and Staggenborg (2002) emphasize the semi-structured interview, where an interview guide is used with questions, but also with topics within in the study as Fischer (2004) suggests.

In our case study we have used semi-structured interviews by using an interview guide. The reason why is that we wanted to be able to ask following questions
depending on the answers, but also discuss the topics with professors and PhD Students. We believe that this strategy has provided us with more valuable information.

2.3.3 Secondary Data
Secondary data is according to Merriam (1998) existing information that has been collected for other purposes. Bryman and Bell (2005) find secondary data very useful since it can provide with basic understanding for the research subject. Furthermore, Kinnear and Taylor (1991) hold that it is not as time consuming as collecting primary data.

In this study we have used external sources such as literature, Internet sources and articles to get a deeper understanding of the topic. The secondary data is the foundation for our theoretical framework but also act as a ground for our interviews.

2.4 Quality of Research
This part accounts for the quality of the research for the thesis by validity and reliability in order to show to which extent the result can be trusted. Merriam (1998) stresses that qualitative researchers need to address the concerns and or challenges for outside readers. She holds that validity and reliability can be achieved through the conceptualization of the study and in which way the data was collected, analyzed and interpreted and also how the results are presented. According to Yin (2003) logical tests can be made to prove the quality of the research; construct validity, internal validity, external validity and reliability which will be described below.

2.4.1 Construct Validity
According to Yin (2003) there is criticism of case study research and he holds that the method lacks a sufficiently operational set of measures. He also states that a subjective judgment is used for collecting data. The tactics we have used to increase validity is to use multiple sources of evidence that he suggest, but also doing interviews with both universities and companies as data sources. Our respondents have checked our report review and in order to clear out eventually
misunderstandings and we have also tried to establish a chain of evidence that is supporting the results of our case study.

2.4.2 Internal Validity

The internal validity is described by Merriam (1998) how the research findings match the reality and handle to capture the reality. To improve the internal validity she enthrones some basic strategies: triangulation, member checks, peer examination and collaborative modes of research.

Triangulation refers according to Merriam (1998) to the usage of multiple investigators, sources and methods in order to confirm the findings. One way of doing this is to use outside sources to validate materials, which we have done by consulting our supervisor in case of uncertainties of important evidence after internally analyzing and interpreting the results from accomplished interviews. This is done in order to increase the validity by triangulation.

During the case study process peer examination is used to some extent since we are collaborating with another thesis groups working with a similar subjects and problems. Similar problems that are recognized have been discussed and the different inputs of the uncertainties have been given in order to find a solution. Merriam (1998) explain member checks as a process of testing whether the results are plausible by taking data and tentative interpretations back to where it derive. The statements based on interviews in this thesis have been approved by the interviewed persons, after accomplished interviews to make sure that we have communicated the same content as the respondent was communicating. We have been able to use the collaborative modes of research collaborate during our research with two other students from Lund University, doing a related part for the case company, namely look into companies that use university as a source for technology. In that way we have discussed the research finding with them and at the same time got the companies’ point of view.
This is done in order to improve the validity of this thesis and by using triangulation, member checks, peer examination and collaborative models of research, the outcome have lead to have a higher validity.

2.4.3 External Validity
To know whether the study’s findings are “generalizable beyond the immediate case study” Yin (2003) refers it as external validity. He state that a single case offers a poor ground for generalizing and that the use of replications and the transfer of multiple-case studies deal with the problems of analytical generalization which in turn increase the external validity. Furthermore, he suggests the analyst to generalize the findings to theory and a case study rely on analytical generalization and often have a higher grade of external validity than a survey based research. We have matched theory with our findings from our case studies in order to increase our external validity.

2.4.4 Reliability
A case study is according to Yin (2003) considered as reliable the procedures of a study can be repeated by other investigators with the same results and arrive at the same findings and conclusions. This is strengthening by Merriam (1998) that defines reliability as “the extent to which findings can be replicated”. Furthermore she states that it is the consistency between data collection and the found results that makes a study reliable.

The goal of reliability is according to Yin (2003) to reduce the number biases and the degree of subjectivity in a case study. He suggests making the case study research as operational as possible by using all steps of the case study research. By following a semi-structured questionnaire we have achieved reliability and all the collected data is saved.

The probing technique discussed by Merriam (1998) is used to further raise the reliability for this thesis and we have conducted XX interviews with professors and researchers at the leading Chinese universities to facilitate as much details as possible, but also to avoid too much generalization or exaggerate the situation.
3 Theoretical framework

In this chapter theoretical concepts are introduced in order to create understanding for the subject. The concept of Open innovation will be explained, followed by a short explanation of Business intelligence with focus on Technology Intelligence and Technology Scouting. An introduction to the concept of Listening Post is given to distinct the difference between scouting (screening) and internalization. This is followed by External R&D in form of Industry-University collaborations in general and more specific in Chinese universities. Network and relationships will be described since it is very important in the Chinese society followed by Chinese business culture.

3.1 Open Innovation

The change from highly centralized and proprietary R&D processes to more market-based forms of organizing innovation describe so far has, in recent years, started to be categorized as “Open Innovation by Chesbrough (2003). The concept of open innovation emphasizes the opportunities, particularly for larger, mature technology-intensive firms inherent in the growing efficiency of markets for technology and innovation state Gassmann (2006). Open innovation treats according to West and Gallagher (2006) and Witzemann et al. (2006) a firm’s R&D function as an open system, with a semi-permeable boundary through which both internal and external sources of innovation are appropriated while internal innovations hold Chesbrough (2006) which could otherwise not be commercialized take alternative ways to market.

A new aspect of the debate and a central argument in open innovation pertains to R&D “spillovers” that Chesbrough (2006). He describes spillover as irrelative innovation that occurs from R&D. Rather than regarding spillovers resulting from R&D activities he regards these spillovers as an opportunity to generate additional value – not through the company’s existing channels, but through alternatives channels such as licenses or external spin-offs. Also Teresko (2004) agree with this by holding that ideas can be spun-out from one organization and spun-in into another.
Chesbrough (2003) suggest that large R&D intensive organization, rather than building competences entirely internally should tap external sources and attempt to find alternative ways to commercialize otherwise shelf developments seems intuitively correct. Billington and Davidson (2010) agree and state that the benefits of exposing internal R&D to outside ideas are recognized by executives during the past decade. According to Chesbrough (2003b) Open innovation make it possible to advance the development of new technologies by active search for new ideas and technology outside the company, but also through collaboration with suppliers, universities, end-users and competitors to create customer value. The challenge of open innovation becomes to filter the surplus of information and to identify those networks of knowledge that the company can internalize.

3.2 Growth of Outsourced R&D
The R&D outsourcing wave initially affected back-end functions of the business which were not considered core to the business emphasize Howells (2008). However, the outsourcing trend hasn’t stopped short of R&D. He argue that cost saving and access to complementary expertise, in addition to speeding up time to market are the main factors influencing R&D outsourcing decisions. Gaso (2005) explain outsourced or external R&D expenditures as capital expenditures of the cost of R&D contracted to outside organizations. He shows the increasing share of expenditure of external R&D and in the US, the share almost tripled from between 1991 and 2001 from 2.8% to 7.4%. In Germany, it nearly doubled from 8.6% to 15.3% between 1987 and 1999. The outsourcing trend is supported by a growing market in suppliers of technology related products and services. Traditionally, industrial firms have tended to outsource fairly standardized, routine, highly imitable tasks, primarily for cost advantages in the form of spot-market transactions.

Increasingly though, more complex bundles of R&D tasks are outsourced according to Engardio and Einhorn (2005), which in some industries bears a risk of making the firm obsolete and being taken over by its suppliers. However, when knowledge is more tacit, and it cannot readily be codified and transmitted, industrial firms have tended to enter into alliances with some degree of systematic interdependence with
one or more partners to pool resources and access complementary knowledge hold Narula (2001).

3.2.1 External I-U R&D collaboration
The benefits of collaboration with external partners for innovation processes are highlighted by Pittaway et al. (2004) and they state that different knowledge, behaviors and habits of thoughts is absorbed of the sources of knowledge. This in turn enhances innovation performance and productivity. They have found that universities is suitable to collaborate with when it comes to radical innovations and according to Gemünden et al. (1996) universities has become one of the most important source in order to find external know-how and resources in the context of technology for firm. It is found from them that interaction with universities result in highly innovative products in the high tech industry.

However, Wright (2008) stresses a potential challenge with the management of IP of Universities in the stage of commercialization. There have recently been published many papers within external collaboration and Van Looy et al. (2004) find that there has been extensive changes that characterize the corporate R&D activities and is spotted by increasing competition in technology markets which has resulted in an growing importance of knowledge and sharing costs and risks within R&D with external partners and in particular through cooperation with academic partners.

Adlerstein and Orton (2009) hold that University-Industry collaborations have proven to be beneficial for both parties. Universities benefit from connections to real-world applications and an employer eager for innovative minds of tomorrow. From the perspective of a University Dooley and Kirk (2007) highlight that universities will get access to source of research funding, deeper competencies and increase the capacity of research undertaken. It also provides increased stability for retaining research staff by bridging the gaps between public funding. It can also increase the access to proprietary technology that is held by industry that facilitates the discovery process. This technology can according to them take the form of process equipment that increase capacity or speed up the discovery time or materials such as chemicals and compound libraries developed by the industry.
Connections with the greatest research pool in the world and access to innovative workforce is the benefit Industry can get from collaboration with universities state Adlerstein and Orton (2009). Dooley and Kirk (2007) have found some key drivers as industrial benefit, derived through university-industry collaboration. Universities have often state of the art competence within its niche area of science where the industry partner may be weak. The company acquires competitive advantage by gaining access to better leads through faster channels than their competitors and thus enhancing the product development process. Another driver is that collaborative research with university can be more cost-effective since universities may already have the infrastructure in place from other research activities.

Elmuti et al. (2005) find that the outcomes and intensity from university-industry collaboration generally lags behind. They also discuss differing cultures of the organization as a challenge since it can impede success and operate on different timescales with different objectives to fulfill, but also different value systems can be a challenge. Another challenge they discuss is the conflicting desire of academia to publish and industry to maintain secrecy to secure IP rights and maintain their competitive advantage.

Dooley and Kirk (2007) find that this form of collaborative research involves a deepening of relationship and offers greater scope for mutual benefits. Advancements of university-industry partnering occur in specialist areas, where the exchange of knowledge and resources increase and a closer alignment between university research output and its industrial partner's requirement is achieved.
According to Dooley and Kirk (2007) this often results in the university investing in certain enabling capabilities which allow it to better fit with its industrial partners needs. Within the biotechnology sector university collaboration enables testing and verification laboratories and discoveries are taken to the industry for commercialization. They state that this increase of interaction between universities and industry allows the industry to benefit from outsourcing e.g. verification activities to universities, but it also benefit the universities since the enabling capability generates new knowledge. The alignment of research output is better with the industrial partners and more defined mechanisms for the knowledge transfer between the nodes of the partnership. As a consequence, research findings of universities can be verified more quickly by industry and the industry data fed back to the university.

3.3 Industry-University Collaborations in China
According to Harryson et al. (2008) China has managed to build a remarkable basis for R&D and is one of the world’s most R&D intensive countries. In upcoming years foreign-based R&D are expected to be even more significant since China also has the second biggest number of researchers in the world. Most companies are still in the process of establishing within Chinese scientific and technical communities because it is a relatively new phenomenon from 1990s for Western MNCs to explore China as a location for R&D activities.

Von Zedtwitz (2004) mentions three entry models for foreign firm that enter China:
1. Wholly owned independent R&D labs;
2. R&D departments or R&D activities conducted under a branch of a Chinese operation or within its joint venture with the Chinese partners; and
3. Cooperative R&D with Chinese research universities and R&D institutes.

It is according to von Zedtwitz (2004) well known that many Western MNCs move their R&D to China for immediate proximity to and collaboration with leading Chinese universities, where 95 where from US origin, 56 of European origin and 32 of Japanese origin. Recently the shift has moved towards European R&D centers in China and over the past six years, more than half of the 600 established R&D centers were of European origin. This trend seems to continue and Astra Zeneca has started to invest $100 million in research in China to set up the Astra Zeneca Innovation Centre China as a part of the initiative. They also have university collaborations with Shanghai Jiao Tong University. Harryson et al. (2008) gives example on companies that collaborate with Chinese universities and mention Bell Labs that have joint research laboratories with Tsinghua University, Peking University and Fudan University. ABB collaborate with Tsinghua University and Tianjin University with the intention to build strong relationships and collaborate on work intensive development tasks.

Harryson et al. (2008) found that Chinese universities know that Western MNCs would like to cooperate with them and some of Chinese universities take it for granted that Western MNCs donate equipment and/or money. Professors consider this as contribution as a gift and as a consequence Chinese universities do not always strive to produce very good research result for Western companies. One issue they address is that the partnering MNC need to follow up on a regular basis with Chinese professors that they really deliver according to the agreement and if nobody follows up, they may not deliver at all. Furthermore, they state that not breaking the trust bond and maintain those checkups like visits between friends rather than imposing the feeling of control is a difficult challenge.

It is according to Harryson et al. (2008) hard to find out who is doing what at Chinese universities since the information is in Chinese and when the right professor is found it is impossible to call him/her to ask for a meeting. In China somebody has to
introduce the company person to the professor to establish a relationship. Many dinners and meetings are needed with the Chinese universities and professors before a collaboration can be decided. It is important to keep a good relationship to those who can introduce you to others or professors that you can work with. Another challenge is to set up a contract, this need to go through the university administration and is a process that can take very long time.

Compared to Western researchers, Chinese researchers have more application driven approach and are more industrial than theoretical which is good for the industry state Harryson et al. (2008). The output of collaboration with Chinese universities depends if the company finds the right research group that possess the required knowledge. Moreover, they claim that collaboration with Chinese universities can be challenging as the Chinese academic institutions are driven by personal connections at the universities. Therefore the key to success is the development of close relationships with professors and universities and to understand and meet the needs of the universities. To establish strong, long-term collaborations with Chinese universities the company needs to adapt to the system and hierarchy.

According to Harryson et al. (2008) is the hierarchical order at Chinese university very strong as the competition to get high positions is extreme. Therefore companies need to start collaboration with the highest ranked university and then with lower ranked or smaller. To be able to start external collaboration the following sections will discuss business intelligence- technology intelligence and listening posts that work as a tool for external sourcing.

3.3.1 Vertical and Horizontal project at Chinese universities

Vertical projects
Vertical projects are according to Han (2010) initiated and funded by governmental organizations and authority institutes e.g. National Natural Science Foundation of China, Ministry of Science and Technology of People´s Republic of China. He explains that the research topics are defined of those institutes and organizations and it is often topics in edge cutting frontier of the academic discipline. Vertical
projects are mostly theory oriented and problem is solved by applying relevant theories.

When applying for a vertical project bidding occur among university research team states Han (2010). During the process an application including research proposal, budget plan and lead time are made, but also a presentation of the team. Mostly, the leading professor in his or her research team is responsible for applying vertical projects and in general, the more publications that are produced during the project, the better evaluation the team will get in the final project review.

To give a deeper understanding, an explanation will be given below to the most common Vertical Programs.

**National Natural Science Foundation**
National Natural Science Foundation is under the direction of Science and technology in National development and planning of national funding for basic research and application projects according to National Natural Science Foundation (2010). It is one of the main channels to support basic scientific research in China. In 2006, the Natural Science Foundation received 63,330 projects, an increase from previous year by 20.3%. The average funding intensity is 261,50 RNB per project, which is increasing every year. 1539 applications for key projects including co-financing projects were accepted and 284 projects were approved funding of 1,6024 million RNB per project (National Natural Science Foundation, 2010).

"863" Project
This is a high technology development plan of China and is Government led with the purpose to develop Chinese High-tech and economic construction to make an important contribution to national security. SOEs are encouraged to participate in these programs. The research areas that the Chinese Government wants to develop is; biotechnology, space technology, information technology, laser technology, automation technology, energy technology, new materials and marine technology. The Central Government invests more than 100 billion RNB each year for the 863 programs and it is the national-level research institutes and universities that are the
leading force within the scientific research for these programs (National Natural Science Foundation, 2010).

973 - National Basic Research Program
The aim for “973” is to develop the implementation of "technology and education" and "sustainable development strategy" to strengthen basic research and technology work by develop original innovation at a deeper level and a broader area in order to improve China’s independent innovation capability and the ability to solve major problems concerning the country’s future development. It also aims to develop in the 2010 mid-21st century as Chinese economic, technological and social development. It is based on closely research within e.g. energy, resources and environment, material and science and technology to provide problem solving theory basis and a scientific foundation, but also the deployment of relevant and important research to explore the forefront and strong basic research. Another objective for the program is to foster the development of high scientific quality and innovatory talents.

From 1998 to 2002 the program has launched19 projects in the material field and international cooperation have been established through academic exchanges (National Natural Science Foundation, 2010)

Horizontal projects
Horizontal projects are according to Han (2010) collaboration between university researcher and external companies. Companies have a more clear application request where companies target university researchers which they approach with one or several clearly defined tasks.

Before project start, contract that clarifies requirements, evaluation criteria, IP ownership, general cost estimate and project compensation need to be signed in an agreement highlight Han (2010). Typically, company covers all costs and pays the university researcher afterwards. The evaluation is in horizontal projects mostly between the research team and the company.
Han (2010) hold that there are various forms of horizontal project and can be a very small joint research project to a joint lab collaboration or even joint research institute that focus on topics of mutual interests.

3.4 Defining Business Intelligence
Business intelligence is seen as technologies that are gathered and data that is analyzed in order to improve decision making processes and to produce new knowledge and business opportunities state Herschel and Jones (2005), BI can according to Kliknaité (2010) be seen as a strategic tool for companies to identify key driving forces and to predict future market directions from gathered information derived from multiple sources.

There are different types of Business Intelligence and Thorson (1997) has divided it into different areas of intelligence; Competitor Intelligence, Market Intelligence, Product and Customer Intelligence, Technological Intelligence, Political Intelligence, Social Intelligence, Partner Intelligence and Know who Intelligence.

The focus for our Master thesis is technology scouting that in our case is a process of screening Chinese universities for technology, which is a part of Technology Intelligence and therefore only this aspect is considered.

3.5 Technology Intelligence
By using technology intelligence a company can save several working hours and brainpower in their R&D hold Buzzanga (2008). As described by Ashton and Stacey (1995) TI is monitoring of new production technologies and business sensitive information on scientific or technological threats or opportunities. They hold that released information of this kind could be harmful to a company´s business. According to Gilad and Gilad (1988) this should be wisely considered by high tech companies in a technological environment.

Cambridge Consultants (2010) describe technology intelligence as an activity that makes it possible for a company to identify new technological opportunities and threats and thus affect a company´s future growth and survival. This is a part of
strategic planning and aims to disseminate the technological information based for decision making. Furthermore, technology life cycles are shorter today because of globalization and therefore the capabilities of TI has become more important.

Buzzanga (2008) state that what he call the Information age was all about building databases, but we have moved to the Intelligence age and thus progress to create contextual access to the right information in order to gain intelligence and insight.

Lang and Mueller (2010) state that strategic planning need technology intelligence in order to identify technological developments in time. They propose linking market need via innovation fields to the technological environment in order to stay competitive on the market. They suggest a set up of a network consisting of internal- and external experts and external information services conducting technology intelligence activities.

“The integration of R&D personnel in technology intelligence activities should result in accessing their know-how while minimizing the additional workload”.

Lang and Mueller (2010)

Lichtenthaler (2004) point out that company should scan outside their current technology and also look for ‘exotic’ information sources such as governmental foresight studies. Furthermore, he suggest science driven companies to find information in external sources such as publications, venture capital funds, start-up fairs and university contacts. This also gives an opportunity to monitor the scientific progress on the market and competition.

3.5.1 Technology Scouting
Technology Scouting is one way of collect external information sources according to Eisenhardt and Santos (2002) and is a form of screening. Technology scouting processes seem to cover a number of stages in order to search for both external solutions and internal requirements state Monteiro (2007) to facilitate the opportunity to transfer external technologies but also to translate and match them to a specific are within the company. He finds that technology scouting is a key stage when it comes to search for external technologies in the environment.
Allen et al. (2001) have investigated the impact of knowledge scouts and found that they play a critical role in inter site communication. They claim that scouts can address many communication obstacles and suggest a systematic approach to use scouts in projects. Furthermore, they hold that it is easier to support a smaller group of scouts than addressing distributed communication obstacles through pure technological solutions.

To delve, dig, explore, inquire, investigate and look into is some description of technology scouting that Thesaurus (1995) has defined. Birkinshaw and Monteiro (2007) define technology scouting as a separate unit established by the firm with the purpose of searching for tacit technological knowledge in order to letting other units within the firm know about potential opportunities or threats.

Gassman and Gaso (2004) have found indicators that show that technology scouting is a very common phenomenon in large companies that face fast technological changes. Doz et al. (2001) point out that scouting units can be established in areas where the company normally do not operate or have any operations to access external knowledge that can be useful for the company. Furthermore, they highlight that technology scouting units have the responsibility to discover new knowledge that lies outside the company’s existing operational network.

Birkinshaw and Monteiro (2007) suggest technology scouting as a useful tool to find new technology and often the scouts are not involved in other operational activities which result in a different mindset than the researchers. Technology scouting unit’s activities should be an integral part of the initiation of the external knowledge sourcing process holds Szulanksi (2000).

Birkinshaw and Monteiro, (2007) find the process of identify external technologies across geographic and technological boundaries highly complex. They stress that the search effort both occur within the firm and in the external environment, but also the importance of be able to transfer the external knowledge into the firm, otherwise the scouting activity will be of no use.
Furthermore, Birkinshaw and Monteiro (2007) have shown two characteristics that facilitate the knowledge transfer process. The first is market credibility for an external technology to be successfully received internally and is similar to what Szulanski (2000) call knowledge proveness and provide with insights of benefits external knowledge can provide with. Nelson and Winter (1992) and March (1991) stress that external knowledge acquisition has a positive impact on innovation performance and Fleming and Sorenson (2001) highlight that external knowledge provide the company with a wide range of choices how to solve a problem. The reason is that they are more able to add distinctive new knowledge variations. The benefit of external technologies is the ability to use the technology since it often has market credibility state Birkinshaw and Monteiro (2007).

The second dimension that Birkinshaw and Monteiro (2007) discuss is knowledge dissonance and work as a barrier to the transfer of the external technology and they determined that external knowledge that go against the commercial or technological convictions are seen as dissonant. It was Festinger (1957) that coined the theory of cognitive dissonance. He suggested that a person´s knowledge, opinion and behavior may be irrelevant to each other and is described as two elements that are is not derived from each other. The problem with cognitive dissonance is that the scouts may search for new information that is not dissonant with other elements according to Browstein (2003) and thus prefer supportive information to avoid post decisional conflicts. Birkinshaw and Monteiro (2007) hold that think of the organizations dominant logic in terms of its business model is the best way to maintain the cognitive dimension.

We will below introduce the most common ways of gathering technological intelligence, namely trend scouts, technology outpost and matchmaker, in the concept of technological listening posts

3.5.2 Technological listening posts
According to Gassman and Gaso (2004) the industrialized world was hit by huge changes that influence the management of R&D over the last decades. Due to globalization which has open up markets and sharpened the worldwide competition,
the product complexity has increased in order to satisfy customer’s needs. They hold that the trend is toward individualization, technology fusion and cross industry innovations. This has lead to an increasing pressure to reduce R&D budget, faster commercialization of products and reduced innovation cycles. As a matter of fact this has forced companies to source external knowledge to bring in and exploit outside-in innovations instead of inventing them themselves. Consequently R&D organizations are according to them being transformed to meet this challenges and established technological listening posts in order to source external knowledge in centers of technological excellence and innovation clusters. Furthermore, they stress that information and communication technology facilitates and enables more decentralized knowledge sourcing activities.

Gassmann and Gaso (2004) define listening posts as “a peripheral element of a decentralized R&D configuration with a specific strategic mission and sophisticated mechanisms for knowledge sourcing”. They identify three epitomes of listening posts; trend scout, technology outpost and matchmaker and are different forms of organization and are categorized in accordance to their alignment and the type processed knowledge.

Figure 3: Archetypes of listening posts
Source: (Gassmann and Gaso, 2004)
Gassmann and Gaso (2004) describe the alignment of listening post as an indicator either the access to direct knowledge sources or the use of indirect knowledge intermediaries. Listening posts are according to them referred to personal contact in order to get direct access to knowledge and indirect knowledge comes from sources on the market e.g. relationships, partnerships, collaborations, co-developments, joint ventures and alliances and are characterized by a high degree of mutual learning.

The different type of processed knowledge is presented and differentiated by Gassmann and Gaso (2004) in trend and application knowledge and technological knowledge, where trend knowledge refers to trends that are market-place shaping and show changes and lifestyle preferences, culture and attitudes. Application is knowledge entails information about future products and how to recombine already existing technologies into new technology.

**Trend Scouts**
According to Gassmann and Gaso (2004) trend scouts are located in lead markets, innovation clusters and trendy areas with the mission statement to gather and acquire trend and application knowledge in order to transfer it back to their home-base R&D. They hold that trend scouts focus is on technological trends, new application area and future potential. Furthermore, they state that trend scouts exhibit a high sensitivity to local markets even though they are not strongly embedded to it.

Gassmann and Gaso (2004) have observed that trend scouts are coordinated centrally and to transfer tacit knowledge job rotation programs is often used.

**Technology outpost**
Gassmann and Gaso (2004) hold that the aim of technology outpost is to gather technological knowledge and transfer it to its R&D home-base and therefore the outpost is located in areas of technological excellence where the scouts have access to universities and innovative high-tech organizations. They point out that a high degree is exhibit of regional

They exhibit a high degree of regional embeddness and close relationships to scientific communities and university collaborations are maintained. However,
technology outposts are independent from their central R&D and can according to Gassmann and Gaso (2004) work with top management commitment.

However, this does not cover universities as a source of technology scouting and consider rather how to internalize and apply the technological information into the company.

**Matchmaker**

Gassmann and Gaso (2004) describe matchmakers as highly regional embedded, organized separately and maintain huge informal network. They highlight that the matchmaker’s mission is to initiate, leverage and establish contacts and co-operations, but also to broker between their company and partners. In this way the act as an ambassador of a company with the purpose to open up foreign innovation sources and matches them with the company organization.

**3.5.3 Determinants of listening posts**

Gassmann and Gaso (2005) have identified four determinants relevant when choosing a specific organizational framework for listening post activities: knowledge acquisition, knowledge assessment, knowledge transformation and knowledge application.
This model shows the four determinants of the organizational framework and their match with the three principal concepts of scanning activities.

The first determinant of *knowledge acquisition* is according to Gaso (2005) linked to the organization’s listening post’s ability to identify and obtain externally generated knowledge and is based on formal and/or informal sources. He explains that explicit knowledge is easily communicative with codified document that is communicated through formal sources, while implicit knowledge typically is acquired through informal sources. Furthermore, he state that implicit knowledge is highly appropriate information and related to certain processes and problems and thus complicated to codify and handle.

Gaso (2005) and Szulanski (1996) describe *knowledge assessment* as the firm’s or listening post’s processes and competencies to analyze, interpret and understand externally acquired information. Professional and methodological competences are according to Gassmann and Gaso (2005) the most vital criteria in order to review
knowledge. They state that professional competencies involve the analytical capability to understand technological information and trends, while methodological competencies refer to monitoring capabilities e.g. applying decision tools or conducting inquiries.

Ad-hoc constellations are often driven by R&D employees ‘personal interest and project-specific needs and Gassmann and Gaso (2005) stress that they are staffed with expert technicians in charge of acquiring and assessing external information. On the other hand they hold that institutionalized scanning units show a large number of information experts with both technical and methodological competences.

Knowledge transformation allows a company or listening post to combine existing and new acquired and assessed knowledge and is according to Gaso (2005) and Zahra and George (2002) referred to the capability to refine processes and routines. Gassmann and Gaso (2005) find that a high degree of internalization is needed when acquiring new competences to transform external knowledge into internal knowledge and is thus common for institutionalized scanning units. On the other hand, ad-hoc constellations exhibit a low degree of internalization, but a high affinity to existing competencies,

These four determinants describe according to Gaso (2005) a firm’s or listening post’s ability to enhance accessible competencies and create new competencies through a successful transformation of external knowledge and his the type of knowledge application. This process takes place in a planned way or accidentally state Zahra and George (2002) and institutionalized scanning units are according to Gassmann and Gaso (2005) strategic embedded and applies knowledge systematically and continuously, while ad-hoc constellations act infrequently and only apply knowledge at irregular intervals.

3.6 Networks

Networks and relationships is according to Harryson et al. (2008) the foundation of China’s society. Therefore it is important to determine network theory in order to create understanding. For companies’ survival, network has become essential due to increasing competition and shortened product life cycles according to Kliknaité
(2010). Gadde et al. (2003) state that networks is resources and describes them as relationships with customers, suppliers and other organizations in three different ways; Relationships are important resources themselves, direct networks bond the company to the rest of the network of which it is a part and every relationship is besides a bridge between actors also a reflector of these connected relationships and their intrinsic resources and lastly the relationships merge the resources, physical and organizational of a company with those of its counterparts. Hite and Hesterly (2001) and Inkpen and Tsang (2005) see network as essential in successful firm when it comes to emergence and growth and hold that networks provide access to resources, knowledge, markets or technology.

Network transfer information augment attitude similarity, imitation and generation of innovations according to Brass et al. (2004). Furthermore, they state that network transfer generate innovations, intercede transaction among organizations and cooperation between persons, but also give differential access to resources and power. Pittaway et al. (2004) claim that networks make it possible for small companies to tap into larger firms R&D resources through R&D collaborations and that is why networks are important as a resource for companies innovation process if it is used efficient and in an effective way.

3.6.1 Innovation networks
This theory explains the importance of innovation networks and how it can be beneficial for a high-tech company. A network allows according to Harryson (1996) consideration of the strategic benefits from the company’s entire network of relationship which is seen as know-who. Network is highly linked to competitive success stress Inkpen and Tsang (2005) since they claim that participation in a network creates potential for knowledge achievement by the network members. Many technological breakthroughs are a result of people participating in networks since scientific knowledge is spread state Bougrain and Haudeville (2002) and thus the locus of novel knowledge creation and innovation becomes the network where the firm is embedded than the actual firm state Inkpen and Tsang (2005).

New technology is complex and Bougrain and Haudeville (2002) stress the necessity to network in order to be able to exploit external scientific technological knowledge in
innovative companies. Networks are according to Easton (1992) stable but not static and work as the vehicle for innovation. Furthermore, relationships continue changing, new relationships are formed and others disappear and thus interaction between companies are stabilized as it happens in the context of existing relationships and provides a platform for change.

Network enlistment must occur for innovation to happen and it is according to Easton (1992) not enough that technological expertise is available since novelty requires changes in network structures and also in the involved firms. Therefore companies must strengthen their existing networks and change old relationships and internal activities, while developing new relationships. He stress that firms within the network need to have resources available for the innovation to succeed and that right combination of resources need to be involved.

Participation in networks with technological approach enhance firm’s product and process innovation success find Gemünden et al. (1996) and Pittaway et al. (2004) found that companies using forms of networking categorized by their relationships with specific parties were likely to have approximately 20% more product improvements and 7%-10% more product developments than firms that did not network. Moreover, network help to spread technological innovation across and within sectors and thus promote development of innovations. Ahuja (2000) find networks useful since it increases innovation input and are important for survival of a firm, but it also requires hard work and time to maintain and enhance networks as said by Pittaway et al. (2004)

3.6.2 Know-Who Based Networks
Innovation networks are vital when it comes to I-U Collaborations in China as it is important to know-who rather than know-how in order to find new technology. Sophisticated networks are according to Harryson (2006) support sophisticated networks creation and application of knowledge where social interaction between individuals, groups and organizations are essential to the knowledge creation process. It can derive from surrounding societal institutions where universities are vital to the corporate knowledge creation process. Organizations are hardly ever able
to generate internally all the needed resources and functions required to maintain themselves state Pfeffer and Salancik (1978).

Organizations innovation capacity depends according to Cohen and Levinthal (1989) on how well a firm manages to exploit and absorb external knowledge. When two individuals interact, Brass et al. (2004) state that they present an interpersonal tie and also the group of which they are members and focus on how information transactions and their know-who is required. When it comes to complex technological developments it is important to know who has the information.

The know-who based companies knows who has the know-how and has according to Harryson (2006) the ability to establish trustful relationships required to acquire that know-how with the multiple competencies needed to transform and apply it in a new context and in that way innovation can occur. He stress that to know who has the know-how gives opportunities for innovation through a more proactive exploration and creation of new knowledge and technologies, while at the same time using know-who to transform it into resource efficient R&D processes for global exploitation of technology innovation.

3.7 Characteristics of the Chinese business environment
When going to China it is vital to understand the fundamental mainstay in the Chinese society. This section will describe the Chinese business environment and create understanding for how it works since it is different from the Western way of doing business. The heart of business networks in China is according to Jansson et al. (2007) the family business system which derives from long time ago. However, this business system is changing due to e.g. movement from command economy to market economy and privatization of State-owned enterprises. They see trends towards opening up the economy with the purpose of making the business environment in China easier. By introducing a property-based legal framework, business legislation and making the rules more favorable enables better possibilities for start ups and companies to enter the Chinese market. Consequently, this make weak institution even weaker and they are forced to go back and rely on the old system.
Jansson et al. (2007) point out that China has a gap between existing and desired institutions, where Western business are more stable, transparent and stronger than Chinese business. Jansson et al. (2007) hold that the relationships in China are based on personal relationships and a collectivistic and holistic thought style in relation to Western relationships. They find that Chinese social relationships are close and built on long-term and within the family it last forever. To establish a new business relationship in China it starts with building up trust and a foundation of fundamentals of it before the actual business starts. Los Angeles Chinese Learning Center (2010) strengthens this by stating that Westerners usually build transactions and if the outcome is successful a relationship will ensue, while Chinese believe that business partners should build up relationships first and if successful, a business transaction will occur. According to Jansson et al. (2007) Chinese relationships is characterized as socially strong based on long-term focus.

Los Angeles Chinese Learning Center (2010) highlight strong relationships are important since decisions also are made subjectively. The Chinese are likely to be flexible instead of planning and budget their business. Chinese are using the time more consciously than Western when it comes to decision-making and to negotiate can be quick or take a very long time depending on their reasons which can be based on emotions. Chua et al. (2009) explain that personal considerations are being aspects taken into business decisions and can interpret as corruption in Western eyes, but not in the eyes of Chinese.

The status in Chinese business environment is ascribed through family connections and the social networks are based on social trust. According to Los Angeles Chinese Learning Center (2010) face is a vital part of the Chinese national psyche and having face means having a high status in the eyes of one´s peers working as a mark of personal dignity. A face can be given, lost, taken away or earned and that is why Chinese are highly sensitive to gain and maintain face in all aspects of social and business life. Jansson et al. (2007) stress that Chinese business networks are closed and particularistic with a low degree of transparency and unclear boundaries and tend to be informal and personal.
According to Chen and Chen (2004) the Chinese equivalent of trust is xin-ren, where “xin” refers to the trustworthiness of a person, with an emphasis on sincerity while “ren” refers to a person’s dependability or reliability. This is built up by strong socio-emotional components and involves personal gifts, shared meals and introduction to family members hold Pearce and Robinson (2000). Lin (2001) describes the concept of trust as Guanxi and is the core in doing business through value-laden relationships. Los Angeles Chinese Learning Center (2010) argues that it is the commercial legal system’s counterpart and is built on personal contacts. According to China Window (2008) the most important is the long-term mutual benefit rather than short-term individual gain. They also develop this further describing Guanxiwang which refers to a network of exchanges or transactions between two parties and beyond. This obtains when person B act as a link and facilitator to connect person A from their network to person C in another network which is made by trust.

The authority system defines according to Jansson et al. (2007) China as having paternalistic networks and centralized decision-making, with hierarchically structured networks followed of the structure of the family firm. They state that the sanction system in China is built on informal rules based on the concept “face” that is an informal sanction system. Furthermore, business networks are ruled by personal relationships and informal sanction are considered more serious than formal ones. For instance, breaking any personal relationship will result in blacklisting instead of being brought up in the court.
4 Empirical findings

In this chapter we present our empirical findings from our interviewed persons divided into: Introduction to the case study, Relationships and networks, Networks and relationships between companies and universities in China, Industry-University collaborations, Adaptation to the industry, Collaboration with Western companies, Increase in industry-university collaboration with Western companies, Using Chinese universities as a source of technology scouting, Determinant factors for collaborations, Company Support and Horizontal- and Vertical Projects.

4.1 Introduction to the case study
Tetra Pak is facing an increased global competition and to stay competitive on the market they are looking for new technological solutions to a) lower their production costs, b) environmental friendly materials that can replace the aluminum in the packages.

Our task is to identify universities that could be of interest for Tetra Pak due to their research areas within polymers in the context of adhesion of paper and clay and barriers against oxygen and water. Other areas of interest are biodegradable and environmental friendly polyethylene and composites such as nano materials.

We have been scouting for both top ranked and lower ranked universities in China that conduct research in the field of materials science. We have visited Chinese universities situated in the Shanghai and Beijing area, which is a part of technological clusters, in order to find suitable collaboration partners for Tetra Pak.
To facilitate an overall picture of the Chinese university ranking table 4 is created. The marked universities represent the universities where interviews were conducted and show their different ranking in Overall ranking, Engineering ranking and Science ranking.

<table>
<thead>
<tr>
<th>Overall Ranking</th>
<th>Engineering Ranking</th>
<th>Science Ranking</th>
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<tbody>
<tr>
<td>1. Tsinghua University</td>
<td>1. Tsinghua University</td>
<td>1. Tsinghua University</td>
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<tr>
<td>2. Peking University</td>
<td>2. Zhejiang University</td>
<td>2. Zhejiang University</td>
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<tr>
<td>5. Nanjing University</td>
<td>5. Tianjin University</td>
<td>5. Nanjing University</td>
</tr>
<tr>
<td>6. Renmin University</td>
<td>6. Huangzhong University of S&amp;T</td>
<td>6. University of S&amp;T of China</td>
</tr>
<tr>
<td>7. Fudan University</td>
<td>7. Xian Jiaotong University</td>
<td>7. Huangzhong University of S&amp;T</td>
</tr>
<tr>
<td>41. Shanghai University</td>
<td>30. Fudan University</td>
<td>44. Beijing Uni of Chemical Tech</td>
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<tr>
<td>61. Beijing Uni of Chemical Tech</td>
<td>35. Beijing Uni of Chemical Tech</td>
<td>45. Shanghai University</td>
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<td>OOR. Renmin University</td>
<td>OOR. Renmin University</td>
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Table 4: University ranking
Source: (Netbig, 2008)

4.2 Relationships and networks

4.2.1 The importance of alumni networks at Chinese universities
According to Yang Han, Industrial PhD Student from Lund University working at Tetra Pak Packaging Solutions in Shanghai, the networks in the academic world are closed, but once you get in, it is very open and easy to get access to others within the network. He highlights the importance of bear in mind that professors are businessmen and they need to benefit from collaboration.

Professor Cao Tingbing at Remini University state that the alumni network is very important in China since many research projects are applied together with others. Friends can help if they work for an institution or company with access to equipment and testing which they can provide them with. In addition, they can also get help when they are purchasing materials when it comes to knowledge, but also costs. Yu Yang and Ren Huifeng PhD Students from Tsinghua University agree and say that
networks are very important, especially to students and professors. The network will according to them benefit everyone since the professor’s academic networks can help students to find a good job after graduation. Moreover, they say that their network is very strong especially with their classmates and research group which probably will last forever.

“The network between alumni and students is very important for her since she apply some projects with her alumni and former students. That benefits my research area and gives the opportunity to discuss and learn from each other”.

Professor Su Zhigiang at Beijing Chemistry University

Professor Liu and Professor Hu at Shanghai University highlight the importance of alumni network since they benefit their network in many aspects. They train students in order to supply industry needs and most of their students is now working for the industry world. That helps the professors getting research support and new projects to work with and they claim that the network is very strong and important for them.

For Professor Kam Sun at Shanghai Jiao Tong University the alumni network is very important and they will have more mutual exchanges. If it is possible for the professor and former students to work together their knowledge and experience can complement the professor.

“A person belongs to the society, which is full with network.”

Yang and Huifeng at Tsinghua University

Yang and Huifeng explain that everyone has network and you never know when they will benefit you that is why it is important to maintain it. A person in China without network will not survive, relationships help people to get jobs, find apartments, connect other people with each other and get help with problem solving in any way.

For Fudan University the alumni network is very important and they got according to Zhang, PhD Student, many funding from previous graduated students, especially in anniversary years. Employees also seek cooperation opportunities for their companies through the alumni network and thus much collaboration between
companies have occurred. He also highlight their yearly parties taking place all over the world and at these convention the former students build up their networks and establish relationships, but many also go there to seek for cooperation chances.

4.2.2 The importance of networks and relationships between universities and companies in China

Zhang state that the relationship between the professor and the company leaders is very important and most of the cooperation is based on personal relationships between the laboratory and professors with the company. He claims that the history of the cooperation is more important than the strength of the ties between the professor and the company. If the result is satisfying of a project, next project in collaboration with the company will also be carried out well, but if it not, the professor will not collaborate anymore with the company. The first collaboration strengthens the relationships between the professor and the company so much effort need to be put into the initial project according to him.

“Many professors received a lot of research funding from the company, at the same time schools and companies enhance cooperation in the industrialization of scientific research. Many researches have been applied by companies. So I think relationships are very important”.

PhD Student Xufeng, Zhejiang University

The network between Remini University and companies is not that important says Professor Tingbing because most of their important sources of funding are from the national projects. Yang and Huifeng, on the other hand, claim that the importance of networks between university and companies depends on the research area, if it is related to the industry area and application, the network is very important. For Professor Zhiqiang the network between university and industry is very important and she highlight that a good cooperation experience and result is very beneficial for future cooperation and can also work as a reference for other companies. The
companies do not only need them and she point out that they also need them in some cases, for example they have some of their experiments in companies.

Professor Tinbing highlight that they do not have to focus on companies because they have enough funding from the government. Company collaboration implies that they need to set up a trust with the company, which takes some time they can use for other purposes. Yang and Huifeng agree saying that some research groups have enough funding from the government with an area not that related to industry application. This kind of research groups do not care about the network between university and companies and do not need to collaborate with the industry in order to get funding. Zhang explain that some professors are not interested in collaborations and rather spend their time and invest in students for projects from the national government.

Opposite to what is said by Professor Tingbing, Yang and Huifeng, Professor Liu and Professor Hu find the network between university and companies very important. They are always trying to keep a strong network with companies as they focus on industry need and the relationship is therefore essential for them. They say that strong ties in the relationship together with trust are the most important thing as the networks and relationships in China are really central. They also believe that the relationship will benefit both parties since the professors can help the company to find new technology applicable to the industry and company needs and the company can supply the professors with interesting and challenging problems to solve. If it is successful the findings can be a breakthrough and it gives them the opportunity to publish it in papers, but also give the professors status in the academic world.

According to Professor Sun communication and exchange is the most important in a network and the exchange can be mutual communication to explore the issue through consultation and cooperation. In particular the company’s communication makes the project more successful. He states that communication and mutual trust lead to a strong ties between the parties and is the core for a successful project.

Zhang sees I-U Collaboration as something good since for example students doing research for Hankoi might join the company after graduation. He explains that
students start to work with the project during their studies and then continue at the company but deeper and in detail.

4.3 Industry-University collaborations

4.3.1 Lower ranked universities have the same prerequisites

Han says that high ranked universities preferably top six, is the best to collaborate with. The reason why is that they have the best professors, equipment, students, quality and also potential recruits there. Ernst Lutz Director for Technology and Innovation in Asia for Alcan Composites Ltd do not agree in this and argue that high ranked universities are expensive and lower ranked are more cheap and he cannot see any difference between high or lower ranked universities. They all need to be taught in project management and it does not matter if it is a high- or low ranked university. He also discusses different student groups that are good to collaborate with, but it depends of what the company will do. He points out that Bachelor students are more flexible in their mind, but need more training. PhD Students are more experienced since they had more hours in laboratories, but they are on the other hand not flexible. It takes the same amount of time for them to be it as it takes for a Bachelor student to learn more. However, his perception is that Chinese students that have been studied abroad mostly return back to China again and these students are more open-minded and easy to collaborate with since they are influenced of the Western way of working and learning.

4.3.2 Professors are business men

Zhang find that professors at Fudan University are more like businessmen and evaluate the importance of doing Horizontal projects depending on the funding.

“It is a very simply business deal, if company give more they will get more”

Zhang. PhD Student at Fudan University

According to Zhang the professors never run only one project so if a company invests 5 million RNB you will get e.g. 50% of their time, but if 10 million RNB are invested the company might have 90% of the professor’s time. It is a balance of time and money since both parties invest and no one knows whether it will be a patent or not
and thus both parties shares the risk. Moreover, he states that if a company pays a lot in the beginning they will get more of time and effort in the project and if a company pays really a lot they will get everything. Besides funding, it also depends on the interest of the research from the professor and if the project is in line with the research area, more students will be put into the project. The professor will gain experience and knowledge that will make him/her progress within his research area. Zhang claims that companies should look for universities doing application within the interested area and looking into whether the university is based on science or application. Depending on which approach the professors have it is more or less easier to establish collaborations. Professor doing applied theories are more likely to do company related projects and they are businessmen.

Professor Tingbing is not neglecting company cooperation either and says that they of course welcome this kind of events of companies, but it depends on the research fields and also the process of establishing trust. Last year, he cooperated with a State owned Enterprise and used his own National Natural Science Foundation investment and when the result came out, the follow-up investment was given by the company. He clarifies that this is a balance and mutual trust need to be established in order to make it work.

4.3.3 Trust is a key for success
However, when collaborating with the industry the relationships between the professor and the company need to be based on strong ties and a trust need to be set up in the relationship when cooperating with each other. Yang and Huifeng agree and highlight the importance of satisfaction from both sides in the end. Professor Zhiqiang says many times that trust is the most important thing, but also the communication need to work out well in order to strengthen the ties between the professor and the company and is also a foundation for trust. To build a strong relationship she holds that the professor and company contact each other often which are important in order to maintain a good and strong relationship.

Professor Tingbing gives an example from his own experience and explains that he has many national projects and other local funded projects to work with. If he is not
interested or does not have trust in some projects or companies, he prefers to refuse the collaboration and instead spending more time on his own projects that he knows are beneficial projects. Yang and Huifeng say that their professors consider the size of the company and also the amount of funding another important factor is whether they can transfer the technology and actually commercialize it.

4.3.4 Industry PhD Students at Chinese universities
Remini University does not have any industry PhD Students right now and when collaborating with the industry it is mostly set up with jointly labs. Some of their students will have a number of working hours in labs and even sometimes in the company. When a corporation is set up he explain that some companies are contact him directly with their exact and detailed problem or project, but they also get projects from personal relationships or the university promotes our research results directly to the company. Tsinghua University has according to Yang and Huifeng no industrial PhD Students since it is not allowed. PhD Students can go to a company for one month, but this kind of collaboration is called business trip. They also have part-time PhD Students where most of them come from different companies. Joint labs are more common though, and they have many of them at Tsinghua University, one example is LG Chem-Tsinghua Joint lab.

Professor Liu and Professor Hu have industrial PhD Students but only depending on that the company needs them. Mostly, they have joint labs with the industry and today they have one with Huayi Group which is really successful according to them. Also Professor Sun look at the demand for Industrial PhD Students and if there is a need they will send them to companies. Another way of collaborating is that the students are offered internship programs from the companies. They also have a joint laboratory with Fujitec.

Table 5 show how the amount of PhD Students is divided in the visited universities.
<table>
<thead>
<tr>
<th>University</th>
<th>No. Of PhD Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanghai Jiaotong University</td>
<td>15/year</td>
</tr>
<tr>
<td>Shanghai University</td>
<td>10-15/year</td>
</tr>
<tr>
<td>Fudan University</td>
<td>80/year in total</td>
</tr>
<tr>
<td>Zhejiang University</td>
<td>8-10/year</td>
</tr>
<tr>
<td>Tsinghua University</td>
<td>45/year</td>
</tr>
<tr>
<td>Renmin University</td>
<td>5/year and research group</td>
</tr>
<tr>
<td>Beijing University of Chemical Technology</td>
<td>40/year</td>
</tr>
</tbody>
</table>

Table 5: PhD Students

4.4 Adaptation to the industry

Professor Tingbing explains that they are willing to adapt their technology to the company’s needs if I-U collaboration is preceded. However, the extent of the adaptation depends largely on how the industry needs looks like and thus it is hard to speculate in before details of the project are given by the company.

Yang and Huifeng explain that the adaptation of their research to the industry is easy if the academic research level or their academic technology is higher than the industry application which is often the case. The knowledge and application is easy to transfer to the industry application.

Professor Zhigiang says that the adaptation depends deeply on what research results the company need, but they will of course adapt their former or other research to the industry application in order to get a satisfying result if that is needed. Mainly they do product development and the company will then do industrial application. The amount of spent hours depend on the size of the project, are they very big they will
put in more PhD Students into it. Professor Liu and Professor Hu explain that they are very experienced in cooperation with companies, which give them an advantage in adapting the academic research to the industry needs. They have also learned from former experiences when they are doing new projects. They state that they adapt the research as needed for the result of the project and that may be why many companies cooperate with them well.

Professor Sun says that he will adapt to the companies requirements and goals and explain the process. They will try to understand all the requirements of target applications, various aspects of the technology needed to form such circumstances and understand the industrial needs. Then they will decompose the project and try to find the basic parts that can be manipulated by the students. Those links need to operate their own so that they can show off and companies to cooperate to implement it. This kind of process is according to him the best way to achieve the goal of the project.

4.5 Collaborations with Western Companies

Some universities announce their collaborations with the industry on their webpage since it is a marketplace for them to get more money claim Zhang. However, they put more information in the Chinese version because the people that maintain the webpage is not written in very good English and thus the Chinese version is more updated. He suggest that the persons looking for information at the universities should be fluent Chinese speaking and reading and it is hard to find the related professor to approach. Furthermore, he suggest companies seeking for collaboration to also bring a Chinese speaking person because the information given in English might not be exactly the same in Chinese.

Zhang also point out that students from abroad can connect professors, e.g. a German student that studied at Fudan University with an English speaking professor connected him with a German professor that now collaborate with each other.

When discussing collaborations with Western corporations Professor Tingbing highlights that there is not that different from cooperation with domestic companies
and Professor Sun agree and say that they treat Western companies in the same way as domestic companies. Yang and Huifeng also agree and Tsinghua University collaborates with both Western and domestic companies and they have not seen any remarkable differences with their collaborations. Professor Liu and Professor Hu treat the cooperation with Western companies and domestic companies in same way, but they mostly have collaborations with Chinese firms today, but they have exchange with Scandinavian Universities. Neither Yang nor Huifeng do have any cooperation with Western companies in their PhD group, but they have academic communication or conferences with Western Universities.

“To our college, both the domestic companies and western companies are welcome to cooperate with us, as we are a college which is mainly focus on application”.

Professor Zhigiang, Beijing Chemistry University

Professor Zhiqiang holds that they have both domestic and Western company collaboration, but no Scandinavian companies in her research group. She knows that other groups may have Scandinavian company collaborations. The dean of their college graduated from KTH University in Sweden and he has many academic cooperation and company cooperation with Scandinavian companies.

However, Professor Liu´s and Professor Hu´s perception of Western companies are that they are good at technology and adapting the projects to their business and commercialize it and they point out that it is a good opportunity to collaborate with Western companies. Professor Sun have little collaboration with Scandinavian companies, but many with Germany and Japan.

DSM from Poland cooperates with the chemistry department at Fudan University and also some Japanese companies, the companies have give them equipment in exchange for help inform Zhang.
4.5.1 Increase in industry-university collaboration with Western companies

Max von Zedewitz from AsiaCompete Ltd state that the total amount of students in China is 26 million and it is still increasing every year by 5% and 35.6 % are studying engineering which also increase every year. Yang and Huifeng state that one reason is that China has become the largest market of the technology area and Tsinghua is the leading University in China. China is now more opened to the world, which has resulted in that many more international companies come to China and Professor Tingbing say that the companies cooperate with local universities to set up both networks and technology. Yang and Huifeng have recognized a bigger interest from the industry and more Western companies are collaborating which Professor Zhiqiang agree in. Also Professor Sun sees that the cooperation with Western companies is becoming more and more from the opening up of Chinas economy.

Professor Zhiqiang cooperates with western companies, but also with other Asian companies from South Korea and Japan. According to Professor Liu and Professor Hu China and especially Shanghai has open worldwide and many Western and international companies come to invest and find a chance to collaborate with universities or local companies and they have recognized an increase in collaborations with companies from Western countries. Also Zhang says that there have been an increase of Western companies cooperation very quickly, especially in the Shanghai area since many Western companies have research departments their and since the opening up of the Chinese market it have become more easier to set up a business in China.

4.6 Using Chinese universities as a source of technology scouting

Companies do not use universities to find new technology according to Zhang and in fact, most of the central research is carried out of the mother company. The companies should know what they can offer the project and it is also an exchange of information, but it is very hard since the companies have many technological secrets they will not tell. His perception is that the information exchange is not mutual and the companies only get information from the university. According to him it is not very common that companies approach university to see what they search for. If a
company ask about a specific topic of the professor it could be quite sensitive, there are some secrets also in universities, but if a company will invest it is easier to get the information.

“If you do not have anything to offer me, why would I waste my time on you?”

Zhang, PhD Student at Fudan University

Professors are very busy so a project proposal need to be mutual beneficial to motivate the professor and this is the difficult part hold Zhang. The company needs a relationship to get an interview and something very concrete to offer or a relationship that can introduce the company for the professor, without this it is almost impossible.

When Western companies use universities in China as a source of technology scouting Professor Tingbing say that they interact with each other in conferences or getting the information from professors, but also from the internet as most of their information is posted on their website. Yang and Huifeng agree and say that international conferences, but also some domestic academic conferences are the place where to get information. Professor Zhiqiang agrees, but adds that most of the companies will get information and find the technology through the professor if they know who to contact. Other possibilities are through conferences and one example is the conference from Polymer Association in China. Moreover, companies should according to them look into publications for more information about their research. These kinds of conferences and publications play an important role as promotion meeting and technology sourcing.

4.6.1 From relationship building to collaboration

Companies that will use Chinese universities as a source of technology, according to Professor Liu and Professor Hu, will visit them on a regular basis to see what is new within the research they are doing, but also contact the professor in person which is the biggest resource for getting information of new research areas or technology. Professor Sun states that most of the Western companies have a stronger ability to self-digestion and absorption and thus strong commercialization ability. The companies are contacting him in a regular basis and they also meet each other to maintain the relationship. For example the development minister of Japan’s
Mitsubishi Electric has a meeting with his research group regularly. Shanghai Jiao Tong University has also a platform for technology transfer centers and it will often be personal information exchange there. Japan’s Omron enterprises find him there through the school and contacted him directly after that.

When a domestic company wants to set up a collaboration they usually call or contact the related professor very often and to maintain the relationship they also do it after the cooperation hold Professor Tingbing. The reason why is to become friend with the professor and in that way get access to his network and thus get more information in the future. Yang and Huifeng strengthen this by explaining that the companies visit and contact the professor in a regular basis to maintain and remain the network and relationship, but also to get more advanced information from the professor. If the collaboration work out well the professor and university will keep the contact and in most of the case continue to collaborate in new projects or come back when new problems need to be solved.

According to Professor Zhigjiang good communication makes it easy to understand each other better, especially if they have a former cooperation. After a good cooperation the companies always contact them in a regular basis to find out what new technology they have recently and what ongoing projects they have. Also Professor Liu and Professor Hu agree and point out the importance of having a good relationship and the companies maintain it by contact and visit us. Professor Sun is sometimes invited to visit companies frequently and last year he went to Japan to visit the R&D Centre, this is a good way according to him to maintain a good and strong relationship.

Professor Zhigjiang explains that mostly companies contact the university directly to discuss in more detail or through personal relationships when establish a cooperation. Former students working in a company can introduce the professor and the company and work as a link. Also Professor Liu and Professor Hu state that the companies come to them and have meetings and most of them are the technical manager officers and come from their alumni and that is why most high level companies directly come to them.
At Shanghai Jiao Tong University the companies that seek for collaboration find Professor Sun themselves, especially foreign companies. Mainly, the first communicate to discuss the project and then it will be decided whether it will be launched or not. Yang and Huifeng explain that the professors often are very busy so it is hard to get in contact with them directly.

In Tsinghua University they have a Technology Transfer Department, which could help companies to set up cooperation easily with the related professor. Most of the companies contact or get cooperation from this department and the professor has always the final decision of the cooperation and thus decides to set up the cooperation or not. Zhang also mention this department and state that companies pay to buy technology and ask for a specific technology to match it. It is according to him former professors from universities working there as well.

“We also want to collaborate with the industry in order to commercialize our patent”.

Yang and Huifeng, Tsinghua University

Yang and Huifeng explain that Tsinghua University also contacts companies when they have conference. Today they collaborate with companies from Italian, South Korean, Japan and USA, but probably not any Scandinavian cooperations.

Zhang state that fame and reputation within the industry also is very important, but the project itself is what really matters. If the professor match the companies’ problem it is likely to work out. Some professors doing consulting in companies and the company pay in that way less money, but have the technology in very long time. Consultancy professors also recruit their students to work with them since they are familiar with the project and the company. This is according to him the easiest way to start collaboration through the former students’ network or alumni and also got the students’ network available. Many students are working as managers and they keep the network collaboration because the relationship between the former student and professor is so strong.
4.7 Determinant factors for collaborations

When research areas are decided Professor Tingbing consider if they are good at the particular area, if they are not, it will not be a high-quality result for the professor and the company.

“My main consideration is whether we are good at this area. Because if not very good at, on both sides are not very good, to me and the company. Both us invest capital and time. If we are good at the subject or field, it is faster and also easy to get started, with a satisfied result”.

Professor Tingbing, Renmin University

The match of research field between the professor and the company is a very important determinant factor for a collaboration to be set-up. They will both invest capital and time into the project so every project is considered very carefully. Professor Tingbing say that if they are good at the subject or field, the decision-making process will be much faster and it is easier to get started and the result will be satisfying for both parts. According to Yang and Huifeng, factors that play an important role are the funding budget and the time required from the professor. Professor Sun also say that the project depends much on the funding and sometimes projects require that the company can do some parts of the projects for example experiments and support with some equipment.

When Professor Zhigiang decide to set up a cooperation she will see whether they can do the project or not and also consider if and how the project benefit their research or future research. The most important thing is according to her if the field is right for our research and how well it match what they are doing and what they have done.

Professor Liu and Professor Hu agree and hold that they will look at the research direction with the project and if they do not have any experience they rather say no to do it.
“The issue of cooperation with Western companies, the main research direction is to see whether it fit, The other is whether the desired results we both have the ability to achieve.”

Professor Liu, Shanghai University

Professor Sun will first look whether he can do the project and if it is the direction of his research. Then the main determinant factor is funding and project time and he has to consider if it is possible to complete with a good result within the time. This is the issues he will consider when cooperating with companies, especially with companies he never collaborated with before.

Han explains that the motivation can be connected to the funding, e.g. one million RNB may not be enough but two million RNB might be and Zhang agree by holding that funding is the most important part. Lutz also hold that the project of course need to be funded, but does not agree with Han and state that money is not the incentive for professors to collaborate and that it is rather the interest of the research area.

4.8 Company Support

Lutz at Alcan Composites Ltd highlight that collaboration needs to be handled with care and by provided plenty of guidance, universities are often inexperienced in collaborating with foreign MNCs. He recommend companies to teach the professor how IP rights work before signing any contracts and to make sure they are owned jointly with the university. He also recommends having quarterly review meeting, seeing what they have done, discussing problems and supporting them. This makes it a good relationship and they are more likely to ask for help when problem is occurred. Furthermore, the workload for a company having university collaboration is according to him about 50% in order to maintain the relationship and to “monitor” the process. He also points out that governmental institutes is less transparent and more closed than in Western countries and it is harder to work with them. He discusses the importance of learning the network to work together and say that the outcome can be very good.
Yang and Huifeng discuss the degree of support from companies they collaborating with and hold that they got some support in form of equipment, labs and business trips to the companies. Professor Zhigiang agrees and says that they besides funding have some equipment from the companies. Furthermore, Yang and Huifeng say that the biggest challenge is the communication to find out what the best result and what research is most suitable for the company. The discussion between the professor and company takes a lot of time since every detail need to be considered. PhD Students working for the professor also need to have plenty of time to discuss. Professor Zhigiang agree, but also once again point out trust and the progress of the cooperation.

The best scenario according to Professor Zhigiang is to achieve the goal of the company and to keep a good relationship for future cooperation. Professor Sun claim that the level of support from the company depends on the project, if the project and the application is closely related the professor can use his students as assistants and they will be involved more or less in the project. He believe it is a good idea to get some extra support from the company where they can answer questions and discusses during the process and in the end the result may be more satisfying.

4.8.1 Extended support in the laboratory
The relationship between the professor and the company must according to Yang and Huifeng be good and they suggest companies to put more time in the lab with the professor and PhD Students to keep a dialogue about problems that can occur, but also to discuss progress in the research. They point out that some of their alumni went to the companies they collaborated with during their PhD studies so the collaborations are an important door opener for the students and it is contributing with an important network for the future which benefit both the career and research. The more time a representant from the company is spending in the laboratory with the students and professor, the easier it will be to recruit for the future among the students. They also argue that the students will be more emotionally involved to the project if they get to know the company better and the students are more likely to take an employment offer at the company after graduation.
According to Professor Sun a good cooperation will lead to continuing work and for them, many companies are suitable to have a long-term cooperation relationship with. A good scenario is if the project each year is expanding, including the payment fee of the project. For Professor Sun an ideal collaboration with a company would be to establish a long-term goal and a sustained cooperation where they set the goals each year, which give the university the chance to show their advantages and business advantages.

Professor Sun finds the culture as the biggest challenge since there is a cultural collision during the process of cooperation. He says that they need to adapt, but foreign companies also need to change itself to accept the Chinese culture and way of thinking. Professor Liu and Hu agree, but highlight that the cultural differences should not be a problem for collaboration. They also point out that this problem makes it even more important that the company and professor have a good and strong relationship based on trust.

4.9 Horizontal- and Vertical Projects

When discussing with Han, Industrial PhD Student from Lund University working at Tetra Pak Packaging Solutions in Shanghai, he state that Universities have more funding from the government than companies in the proportion approximately 60%/40%. In industry cities like Shanghai the proportions for company based funding may be higher since the interest for collaborations there is higher. He says that it is impossible to get access to the high ranked universities if you do not have any relationship with them. For example Tsinghua University that is ranked as no. one does not need the money since the government is funding them to a great extent. He explains that a professor has a team of 12-15 Master students and PhD Students and that limit them from taking too many horizontal projects.

Han also suggests companies to look at the professor's publications and papers, but keep in mind that this is good for PR for the university. One professor might for instance have plenty of publications and has a very academic approach, while another professor can be more industry oriented and developed many types of equipment and have thus a small amount of publications.
<table>
<thead>
<tr>
<th>University</th>
<th>Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tsinghua University</td>
<td>&gt;500/year</td>
</tr>
<tr>
<td>Beijing University of Chemical Technology</td>
<td>300-400/year</td>
</tr>
<tr>
<td>Renmin University</td>
<td>20/year</td>
</tr>
<tr>
<td>Shanghai Jiaotong University</td>
<td>500/year</td>
</tr>
<tr>
<td>Fudan University</td>
<td>120/year</td>
</tr>
<tr>
<td>Shanghai University</td>
<td>30/year</td>
</tr>
<tr>
<td>Zhejiang University</td>
<td>70/year</td>
</tr>
</tbody>
</table>

Table 6: University Publications
Source: (Empirical data, 2010)

4.9.1 Chinese university funding system

According to Yang there are two different kinds of laboratories owned by the Central Government State laboratories and Province laboratories. The State laboratories are directly owned, managed and mainly funded by the Central Government, but some are also funded by SOEs that are selected by the Central Government to join and support State laboratories. Most of the State laboratories are managed by the universities and some professional research institutions and they get Vertical projects directly from the Central Government.

He explains that the majority of the laboratories are state-owned research institutions, which are very strong in a particular research area and thus universities who has State laboratories have deep knowledge and a high level of the special research field. Hence, to have a State laboratory at the university strengthens the Government´s and universities´ R&D as it provide a large amount of funding.
The Province laboratories are directly owned and managed by the Local Government and are mainly funded from them and local companies clarifies Yang. The Province laboratories are managed by the universities and get their projects from the Local Government that benefits them with preferential policies. To develop a province whole technology or social science study and to improve the Province, the Province Government chooses some universities as key local or key province universities. These universities get the financial support from the Province Government and also preferential policies are given to the universities. Moreover, the key universities also get equipment support from the Local Government and local organizations and companies.

Figure 5 is our interpretation of Yang’s description of the connections of the different institutions at Chinese universities. The Central Government is in charge of Chinese universities. On the left side of the figure, Central Government connects the State-owned Research Institutions which in turn connect the universities with the State Laboratories. This is followed by the professor that is responsible for the conducted research in it. On the right side, the Provincial Government connects Provincial Laboratories with universities in the province and the professor in charge of it.

Central Government supply Chinese universities with vertical projects that are providing them with funding. Companies are creating horizontal collaboration opportunities that provide the professors and the universities with funding.
4.9.2 Vertical project application process
Most programs Fudan University is applying for according to Zhang are open for all universities and they upload a business plan that will be reviewed. He also explains that some programs are secret e.g. military related projects and some universities or department are being approached directly if only a specific professor and laboratory have the skills and equipment to do the project. The process of selecting the universities that got the program they are applying for is like a bidding process and government compare the business plans and evaluate the equipment. The most important is the professor and his or her experience in the program or related knowledge.

4.9.2 Vertical projects and funding
Zhang’s group have 4 million RNB funding for five years. They got funding from the central government and there are other programs as well they got funding from such as National Science foundation. He explains that there is hundreds of thousands programs and other program can be from Shanghai scientific foundation funded by the local government in Shanghai and from different education departments from...
government. This means that the universities can get money from everywhere basically.

Remini University has according to Professor Tingbing many Vertical projects such as 863 projects and 973 projects, but also many projects from the National Natural Science Foundation. Besides that they get many projects from Beijing local government and National government to work with. The mainly funding is from National Natural Science Foundation and this year for example they cooperate with National Science and Technology Department from which where they also are funded. In total they got approximately three million RMB.

Tsinghua University have according to Yang and Huifeng many Vertical projects such as 115 National Science and Technology Support Program, 105 National Key Project, 95 National Key Project, 973 Project, 863 Project, National Natural Science Foundation research project, The National Natural Science Foundation of Hi-Tech projects and many more. Besides that they have much cooperation with the military which is secret.

Beijing Chemistry University has according to Professor Zhigiang undertaken and completed more than 180 Provincial science research projects during the last five years. They have been awarded 20 of the national, provincial and ministerial awards from these projects. At the present time they have national scientific and technological research and 27 projects of 863 projects and 973 projects, but also 21 projects of the National Natural Science Foundation and more than 30 of Ministries projects. This year, they have over 100 million RMB funding from the government and a total number is several million from company based projects.

Professor Liu and Professor Hu have vertical project such as ten projects of National Key research projects, 17 projects of 973 project, 16 projects of 863 project and more than 80 projects of National Natural Science Foundation. They say that Shanghai University is very special since Shanghai local government invests a lot to their university. As a result they get much financial support from the government and in 2009 only their college had over 90000000 RMB from the government.

Shanghai Jiao Tong University have many Vertical projects such as SixFive, SevenFive, EightFive, NineFive, TenFive, States Technology Projects, The National
Natural Science Foundation Project, 863 and 973 project and National Defence Project. The government funding in each project is different, but mostly around 500 million RNB per project. Sometime Professor Sun even finance his projects himself if he thinks the research is needed and it is a worthwhile project.

4.9.3 Horizontal projects
Zhang knows that Fudan have horizontal collaboration projects with Dow Chemistry, Hankoi and BASF. The companies are having some project that they later give to the laboratories so the students can do the research that often leads to internship possibilities for the students at the companies. He believes that the funding is at least tenth of thousands RNB and the money are going to the university and some of them to the laboratory that in turn give some of the amount to the students working with these experiments and research.

The funding from companies is very low in relation to funding from the government according to Zheng, but Shanghai University have many professors doing more applications and more horizontal based projects, thus their funding is higher from companies than the government. It depends highly on the university and the professor

Renmin have Horizontal projects with local or other domestic companies, but not that many.

“In fact some companies also contact us, such as some local or other domestic company. We have some cooperation with some companies. Till now, we don’t have any cooperation with western company. Not that many”.

Professor Tingbing, Renmin University

The reason why Professor Tingbing does not have any collaboration with Western companies might be the ranking of the University. Western companies seek according to him for high ranked universities as they mostly have more publications and patents.
Shanghai University is collaborating with companies such as Haizhen Group, Changzhou Sunshine medicine Group and Changchun Chemistry institute. Shanghai Jiao Tong has horizontal collaboration with China National Tobacco Board, Mitsubishi Electric of Japan, Fujitec Cooperation and Alcan. Tsinghua University on the other hand has many horizontal projects. They are for example collaborating with China Petroleum & Chemical Corporation Project, LG and some more. Tsinghua University get at least ten times more funding from vertical projects than horizontal projects and one governmental project is around four million RNB.

Companies Beijing Chemistry University cooperates with are for example Yantai Wanhua Company, Hao Hua companies and Fine Chemical Company. They have a fixed capital investment each year and some of the companies have joint labs with us.

“We also carry out a number of joint research projects, scientific and technological achievements and produced a large number of applications”.

Professor Zhigiang, Beijing Chemistry University

Their research funding in 2004 was 25 million RNB, in 2005 41 million RNB and in 2006 up to 50 million RNB so there has been a steady increase for the university that means a lot. Professor Zhigiang said that they already have set up many close relationships between domestic and foreign large or medium sized enterprises. They are also carrying out a number of joint research projects, scientific and technological achievements and produced a large number of applications. For instance, China Plastics Processing Association of Professional Committee of multifunctional masterbatch and color masterbatch, Non-silver photographic association and the Chinese Society for Corrosion and Protection, Education Commission and non-metallic materials science, Corrosion and Protection Institute of Professional Committee belong to their University.
4.9.4 Summary of vertical and horizontal projects

Yang highlights the importance of knowing how the professor’s workload is divided between horizontal and vertical projects. If the professor is busy with many vertical projects he will not have time to generate good quality of work for the company.

<table>
<thead>
<tr>
<th>City</th>
<th>University</th>
<th>Vertical Projects</th>
<th>Horizontal Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shanghai University</td>
<td>10 projects of National key research projects, 17 projects of 973 Project, 15 projects in &quot;863&quot; Project More than 80 projects of National Natural Science Foundation</td>
<td>Haizheng Co.Ltd, Huayi Cooperation, Shanghai Coating Institute, Rizhisheng Company</td>
</tr>
<tr>
<td></td>
<td>Fudan University</td>
<td>“973 “Project, “863” Project National Natural Science Foundation Projects, National key research projects</td>
<td>Yunnan Biomedical Science and Technology, Sinopec, BASF, Eastman Chem, Rohm &amp; Hass, 3M, Unilever, National Starch, DSM</td>
</tr>
</tbody>
</table>

Table 7: Summary of vertical and horizontal projects at the universities part 1
Source: (Empirical data, 2010)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing University of Chemistry and Technology</td>
<td>27 projects of “863”, “973” National scientific and technological research, 21 projects of the National Natural Science Foundation, &gt; 30 of Ministries Projects.</td>
<td>Hao Hua cooperation, Beijing Fine Chemical Co., Ltd, Yantai Wanhua Company</td>
</tr>
<tr>
<td>Renmin University</td>
<td>“863”, “973” National Natural Science Foundation, Beijing local government, National government Project</td>
<td>State-own companies (especially in Beijing), Beijing Xinghua Company</td>
</tr>
<tr>
<td>Hangzhou</td>
<td>Zhejiang University</td>
<td>3 projects of “863”, “973”, &gt;40 National Natural Science Foundation (incl.2 major projects and 7 key projects), National science and technology supporting projects, &gt;70 of the provincial Department Fund Projects</td>
</tr>
</tbody>
</table>

Table 8: Summary of vertical and horizontal projects at the universities part 2

Source: (Empirical data, 2010)
5. Analysis

In the Analysis chapter the major theoretical concepts, discussed in the Theoretical Framework will be applied based on the data and finding of the Empirical Study with our own reflections and experiences from China.

5.1 Chinese university networks

Our perception is that the relationships between professors are very strong and they seem to know what those, who do not work at the university anymore, are doing. Professors are even using their networks and relationships for collaborations and some research project applications are written together with others. There might be many different reasons for why professors are applying for projects together and we claim that it is because of risk sharing, accomplished knowledge and experiences. Collaboration between professors can also secure that they will get the project they apply for. Moreover, collaboration between professors can also give access to equipment and more students. The former student and professor can also exchange knowledge and information between each other that can benefit them both. We find that Chinese University network is the same as the theory describe a business network.

We got recommendations to professors at other universities and this worked as door openers for us, which also would be the case for companies seeking for collaborations. Even though it is decided not to collaborate with a certain professor, he or she can give recommendations to the companies of other professors that have a better match with the company project. Technological listening posts theory is in accordance to Gasmann and Gaso (2004) referred to personal contact in order to get direct access to knowledge. Indirect knowledge comes from sources on the market e.g. relationships, partnerships, collaborations, co-developments, joint ventures and alliances. A company collaborating with a professor can get access to other professors and become a part of the vast academic network in China.

In China network is the most important element in the society as all our respondents have highlight that you practically have everything if you have a good network and relationships. The universities benefit from the alumni network when it comes to
funding, business opportunities, and help to get into others network or access to knowledge. We have also experienced the importance of network since all our interviews are based on personal relationships. The empirical findings also show that Chinese university networks are closed, but once you are in they are open. We experienced it firsthand as PhD Students have introduced us to professors and professors have recommended us to contact professors at other universities. This is Guanxiwang which refers to a network of exchanges or transactions between two parties and beyond discussed by China window (2008). The theory states that finding the right person who can introduce the company to a university or a professor is vital for finding collaboration in China in accordance to Harryson et al. (2008)

The empirical findings show that professors would never do a job that is not related to their areas or have good potential to succeed because their reputation can be damaged. That would affect other people’s perception about the professor in the network and also the position and ranking within the network can be changed. In the Chinese business environment concept Jansson et al. (2007) refer this to “face” and a failure will result in that the professor loss his or her face which Chinese are highly sensitive about. The Chinese I-U collaboration theory by Harryson et al. (2008) also highlight the importance of monitoring the project discretely since the researcher can manipulate research results, in order to prevent the professor or researcher responsible for the project not to lose face

Professors and students build up their network and relationships during their studies that can benefit them in the future, former students with management positions contact professors for collaborations or former student colleagues that have businesses that can be beneficial for cooperation.

The yearly Fudan University alumni have conferences all over the world and make it easy for former students to keep in contact, but also to get to know what others are working with. People that live in e.g. USA can keep in contact and extend their own networks there.

In accordance to the network theory by Kliknaité (2010), network is essential for companies’ survival in the global competition and it is during the past decades
companies pay more attention to this. The world is fast moving and what was new yesterday is old today since the technology is developing fast. Network and relationships are today seen as a resource and valuable asset for a company according to Gadde et al. (2003) and their concept of network. Relationships bond networks together and thus the brainpower within these networks is immense. The information transfer taking place within a network not only keeps people updated, but also helps to generate innovations. We have during our stay in China understood how big a network can be since it is widespread over the world and what opportunities and possibilities that can be created.

Chinese people are born to network and the Chinese society depends on this when it comes to survival for the individual. We can see from our empirical findings that companies are aware of vast university networks as they use them as a source for new technology, but they can also find recruits that already worked with some of the company’s projects. By doing this, relationships can be established and the students will be emotionally attached to the company, thus they are more likely to take a position at the company. In that way companies have an employee with personal contacts at the university and with a related professor that can benefit collaborations and the company. Harryson et al. (2008) find in the Chinese I-U collaboration theory that professors have a tendency not to use their best students for company collaborations as they want to use the students themselves. On-site collaborations are not that common as in Western companies which can result in difficulties to get talented students working with the projects and thus the recruitment possibilities among top students seem to be harder than expected.

“Network mobilization must occur for innovation to happen” say Harryson et al. (2008) in the form of new structures which means that a company need to strengthen their existing relationships and at the same time create new. By knowing the right people that will give access to the right network a company can drive innovation longer than no one thought. If a company has the needed resources available for innovation it will succeed if they have found the right networks. In Chinese networks this is applicable as trust is built up and all parties invest in time and money.
Ahuja´s (2000) network theory claims that networks will increase product improvements and innovation, since it supply with input from others that in turn can create better solutions affected by others thought styles. In accordance to Bougrain and Haudeville (2002) innovation network theory, technological breakthroughs are a result of people participating in networks and we have found that many companies collaborates with universities in China in order to find new technology that can help the companies to stay competitive on the market within their particular industry. Even if the research is not done within the exact related area, research result and findings can be used in another area. For example research findings within medicine can be used within the packaging industry. If the company have the capacity to absorb information and internalize it, Chinese university network is very useful in order to find new technology. The problem Harryson et al. (2008) address in their Chinese I-U collaboration theory is that Western companies are not very good in transfer the knowledge into the company and we believe that this can be learned from Chinese companies that are more experienced to do this. On the other hand, Chinese professors perceive Western companies being good at transfer the knowledge and internalize it.

5.1.1 Relationship building
In accordance to Chua´s et al. (2009) theory about Chinese business environment decisions are made subjectively and personal considerations are taken into decisions when doing business with Chinese. Therefore trust is the first step into a relationship in China, which also the respondents highlight very clearly. Chen and Chen (2004) discuss xin-ren that is built up by strong socio-emotional components and often includes personal gifts, shared meals and family introduction. According to the empirical findings companies meet the professor they collaborate on a regular basis and as we understand, it is based on winning and dining in order to strengthen the relationship. As discussed by Harryson et al. (2009) in Chinese I-U collaborations theory, this stage requires a lot of investments in time before collaboration will be considered since trust need to be established between the parties. In China it is important to follow a hierarchical top-down approach which is the opposite from what is done in Scandinavia. Chinese professors are expecting to be introduced to a manager from the company.
A relationship must be established before cooperation holds the Chinese business environment theory by Jansson et al. (2007). Respondents suggest that a half time working employee from the company should maintain the relationship. Professors expect the companies to invite them or taking them out for dinner and other activities to show their good will. Another reason is the chance to get to know the other party better before they decide whether collaboration will be set up. As we learned from our time in China, work, family and background are topics that they might ask for in order to get to know persons better, but also to find out your ranking in the society.

The relationship between professor and student is strong and built on mutual benefits since the professor trains the students to supply industry needs and sometimes helps them get a good job. In return the students help the professor getting research support and new projects to work with.

In accordance to Easton (1992) innovation network theory relationships are changing and then new are formed and others disappear, but the empirical findings contradict this, as in China relationships seems not end if you once had a relationship it will last forever. We have found from our empirical findings that relationships that are strong will continue to be it, even if the personal contact is not consistent and mutual trust is the key.

5.2 Industry-University Collaborations
Pittaway et al. (2004) state in the External I-U R&D collaboration theory that universities are suitable to collaborate with if the company is working with high tech and radical innovations. Universities has become one of the most important sources for finding external knowledge and it is found that interaction with universities result in highly innovative products in the high tech industry. We have found that there is a difference between application and science and the professors have different focus on this within their research. The empirical findings show that professors that have many publications and papers are more oriented towards doing theoretical research than practical, since those professors that are applying theory do not have time to produce that many papers and publications.
However, Chinese researchers are doing more applications than Western professors in accordance to Harryson’s et al. (2008) concept of Chinese I-U collaboration. Those that are doing applied theory are more likely to collaborate with the industry since they also gain knowledge and experience from projects that can benefit future research or reward them. As shown in the Table 3, lower ranked Chinese universities are doing less publications and papers than the high ranked, with an exception from Zhejiang University.

The respondents have not seen that many difficulties when collaborating with Western companies, but some of them mention natural cultural differences that also the theory point out. The traditional academic path collides with commercialization activities and that is why it is important to select professors that are doing applied theory if the company wants to commercialize the result. However, Chinese universities have a bigger industry approach than Western Universities and much collaboration have resulted in a big amount of publications in accordance to the Chinese I-U collaboration concept of Harryson et al. (2008).

We have found that the match between the project and the professor’s research area is the most important determinant for cooperation, but also funding and invested time are factors that have a big impact. The company needs to consider carefully how to pay the funding and the more they give the more they will get. The empirical findings suggest a bigger payment in the beginning of the project to get more students and time on the project. However, the Chinese I-U collaboration concept of Harryson et al. (2008) find that the universities and professors see funding and support with equipment as gifts rather than payment in the initial stage of collaboration that companies must keep in mind since it can be very costly collaborate.

We noticed that universities in the Shanghai area are more interested of doing I-U collaborations. It is also in the Shanghai area MNCs has set up their R&D units in China. Shanghai is according to theory the most international city in mainland China and the professors are more industry driven and businesslike than in other cities. R&D organizations are according to Gassmann and Gaso (2004) Technological listening post theory forced to source external knowledge in centers of technological excellence and innovation clusters.
In Beijing for example, the universities are more funded by the government and therefore they do not have a need for collaboration. Professors only do it if they find the research interesting. One exception is Tsinghua University that is China’s highest ranked university. They have a Technology Transfer Department where companies can ask for help for a specific problem and the department tries to find a matching professor they can contact.

It is of highly importance for the professors that the project matches their research area and interest. Otherwise they will rather refuse to do the collaboration and instead spend more time into his or her, own vertical projects that are beneficial for them. In accordance to Van Looy et al. (2004) theory about External I-U collaboration the growing importance of sharing knowledge, costs and risks within R&D with external partners through cooperation with academic partners. Risk sharing is the critical element and professors feel highly responsible for the project and to fulfill his or her responsibilities.

Some universities have industry PhD Students, but it seems like they are adapting this to the demand from the industry. However, many PhD Students are sent to companies for project related work during a period and the student get working experience while the company obtains competence. As mentioned before, Harryson et al. (2008) state that professors rather use top students to their own projects than give them away to companies and it seems like they only give them away if it is really necessary. Moreover, it is less lead time to have a jointly laboratory at a university than having an industry PhD Student.

PhD Students and professors are positive to I-U Collaboration since it benefits the students as many collaborations result in internship, job offers and continuing collaborations with the professors. Also the external I-U collaboration concept by Adlerstein and Orton (2009) support that collaboration between universities and industry is beneficial for both parties and the same incentives are given as the respondents. The universities get access to funding, competencies and equipment that can speed up the process for them. At the same time the industry get access to the world’s greatest research database and can also look for potential recruits to their company. Professors are tricky and doing bad hoax in order to get as much benefits
as possible from the collaboration in accordance to Harryson et al. (2008) theory of Chinese I-U Collaborations. Thus, collaboration is not always mutual beneficial or a win-win situation for both parties. We agree with the theory and find that this is a mindset deeply rooted in Chinese people and ask companies to be very careful.

In compliance with Von Zedtwitz (2004) Chinese I-U collaboration theory one way of collaborating is by setting up a joint lab where the company provides the lab with equipment and materials and in return the professor does research for the company in the lab. For succeed with a joint lab we find that the relationship between the company and the professor need to be well established and strong. Therefore we suggest collaboration for trial and relationship building, before investing for long time collaboration in order to see what result the professor can get. Also in this case it is important to monitor to some extent since it is very unclear if they will fulfill the agreement as discussed in theory. ‘

Many of the professors have highlighted the importance of that cooperation should work successful. If it is not, the professor will not have any future collaboration with the company. They say that the first collaboration strengthens the relationship and that means that unsuccessful collaboration will not have any strong ties. As Chinese people have the network system deeply rooted a failed collaboration can result in difficulties for the company to find other collaborations with universities, since the professor’s network also is very massive and strong that also is in line with Jansson et al. (2007) Chinese business environment theory.

According to the empirical findings professors are like businessmen and they need to benefit from the collaboration as well. A company needs to offer them the right amount of funding and sometimes equipment or other “benefits”. Professors have a high rank in the hierarchy in the Chinese society and many of them are skilled negotiators when it comes to doing business. The professor is the boss of the student and outstanding students can get access to the professor’s network and also job offerings. When doing interviews, many PhD Students did not want us to mention their names, the reason why was that they were afraid of getting publicity instead of their professor. In accordance to Jansson et al. (2007) Chinese business environment China is hierarchical and that support the empirical findings. The
professor is the boss and should therefore be the honored person and not the student that is of a lower rank within the hierarchy.

5.2.1 Collaborations with Western Companies
The shared information on the universities webpage in English is not updated as the Chinese version. From our own experience and empirical findings, we find that it is more timesaving to let a fluent speaking Chinese person search for patent, publications and professors at universities’ web pages.

We have found that students and former students can facilitate a contact with professors. Many of the Chinese universities have exchange programs with European and Scandinavian universities such as, Chalmers and KTH in Sweden. If a company look into employees’ networks, it is possible to find a door opener into Chinese universities.

The respondents hold that they treat Western companies in the same way as domestic companies and rather focus on the research area than nationality. As mentioned in the empirical findings there have been an increase in Western companies that collaborate with Chinese Universities. China is driving the technology forward and there is a raise of companies that are present on the Chinese market. Western companies collaborate with Chinese universities to set up local networks, but also to find new technology in order to stay competitive on the global market. Universities have according to theory I-U collaboration concept by Harryson et al. (2008) the latest research and Western companies gain competitive advantages by getting the new and innovative technology, but also access to the greatest network in the world. Since the opening up of the Chinese market, universities and professors seems more curious of the Western world and are more open to collaboration with it. It will result in mutual exchange of information and knowledge that can benefit both parties.

However, difference in culture of the organization can be a challenge if the value systems, timescales and objectives are diverse in accordance to Elmuti et al. (2005) concept of external I-U collaboration. In China we have found many differences in
their culture and collaboration will be a challenge for both parties. The company needs to adapt to the Chinese system and at the same time educate the involved Chinese in project management in order to succeed.

Cultural difficulties can be a problem and some professors find it to be the biggest challenge in collaboration with Western companies. Both parties need to adapt and Western companies need to understand and accept the Chinese culture and way of thinking for a collaboration to work out well. The only way of doing this is by investing in the relationships in China to learn and create bonds between the company and the professor.

The theory of Chinese I-U collaborations in accordance to Harryson et al. (2008) claim that it is vital to have an employee working as a “middle man” preferable raised in China that will save time and also make the process more smooth. In the Technology scouting theory, Allen et al. (2001) have investigated the impact of knowledge scouts and found that they play a critical role in inter site communication. They claim that scouts can address many communication obstacles and suggest a systematic approach to use scouts in projects. The “middle man” should have a good network within the academic world to be able to open doors and help the company to make new important connections. The concept of having a middle man can be compared with what Gassmann and Gaso (2004) call matchmakers in their Technological listening post theory. A matchmaker is described as a person that maintain informal network with the mission to initiate, leverage and establish contacts and co-operations. Other tasks is to broker between their company and partners with the purpose to open up foreign innovation sources.

Good communication is essential when collaboration is set up, especially when Western companies are collaborating with Chinese universities. It is important that both parties understand each other and new collaborations can easily be established in the future. If the company is present on a regular basis the understanding for each other will develop much faster and also trust and the relationship will be built up. These challenges will be fewer if the professor and the students working with a project can discuss problems, progress and uncertainties with the company. We have experienced that Chinese people do not want to address problems or ask for help
since it is a sign of weakness. Students are not used to ask for help, as they are taught that it is their problem if they do not understand. Another reason for doing visits on regular basis is to monitor the progress and to make sure the professor fulfill the agreement as discussed in the Chinese I-U collaboration theory by Harryson et al. (2008). When doing this, carefully needs to be considered as it can be an issue of trust which can destroy the relationship.

The perception of Western companies is that they have a stronger ability to self-digestion and absorption, which affects the commercialization ability. It seems like professors find it important that the companies they collaborate with have a good ability to absorb knowledge, which also makes it more likely to be transferred into a product, and thus commercialized.

5.2.2 Adaptation to the industry
All respondents state that they will adapt their research and technology to the company’s needs and this is an easy process if the academic research stage or academic technology is a higher level, than the industry application. In accordance to Adlerstein and Orton (2009) universities offer the greatest research pool in the world and access to innovative workforce. Mostly the universities have made a greater progress than the industry and the research project can be transferred to the industry if the research purpose is enough detailed. Often can the professor develop or use previous experiences and adapt this to the company project and it is just a matter of time. Make sure though, that the company has knowledge about this so no payment is made for already existing research result.

It seems like the universities are willing to adapt to the conditions when it comes to amount of spending hours and they will put in more students into the projects if it is needed. We find that the professors sees this as an opportunity for their students to practice real business projects that will prepare and benefit them in the future. That can also be beneficial for the professor if the project experience can help them to find good working positions.
Due to the empirical findings we find that professors are more likely to collaborate if the project can be divided into different parts that his or her students can work with. For example Master students can work with basic parts and PhD Students with more advanced research together with the professor. If the company can “sell” the project in a way that the professor effortless can see who can do what and calculate for the time, it is appreciated from the professor. In accordance to Dooley and Kirk (2007) collaborative research involves a deepening of relationship and offers greater scope for mutual benefits. By trying to arrange a set-up that can benefit both parties and help the professor save time by involving students, can make the professor more eager to adapt his or her research to make a better match to the company´s project.

As mentioned before, company needs to educate the project group in project management. The willingness of adaptation of the professor´s research is a good sign for willingness of adaptation to the company. If the professors are willing to learn and both parties can adapt to each other the collaboration are more likely to be successful.

We can see that Western people are highly regarded in Chinese society and the professors are more likely to listen and adapt if a Western person is managing the project and maintain the relationship. Also Harryson et al. (2008) suggests that companies send a senior manager to establish the relationship and also sign the collaboration agreement, but then another scientist can drive the project.

5.3 Using Chinese universities as a source of technology scouting
Birkinshaw and Monteiro (2007) suggest technology scouting as a useful tool to find new technology. When using Chinese universities as a source of technology scouting the offer made by the company needs to be mutually beneficial for both parties. If collaboration is not beneficial for the professor there is no reason for the university and professor to collaborate as the professor´s time is too valuable. The most common way of using Chinese universities as a source of technology scouting is to approach the professor related to the area of research directly with a very specific and detailed problem. The person should also have great knowledge within the area to be able to have fruitful discussions. The respondents have no previous experience
of students doing scouting and our perception is that it would be more rewarding to send a representative from the company and a local Chinese or a fluent Chinese speaking person for best response. To have an employee or consultant doing the scouting would be the most successful if the company has serious intentions of finding a partner to collaborate with.

Professors and companies interact with each other in conferences where information exchange is taking place, therefore it is important for companies to participate in this kind of event to both establish and build up relationships.

In accordance to Gassman and Gaso (2004) trend scouts focus on technological trends and new application areas. All the respondents state the importance of regularly visits in order to maintain the relationship, but this is also a good opportunity for information exchange, to see what is new within the research area and technology. Invitations to the company also seem to be appreciated and it shows that the company trusts the professor and put some effort into the relationship.

Foreign companies mainly contact the professor to discuss the project to decide whether it will be launched or not. It is hard to say how long the process will be since it depends on the project, chemistry between the interacted persons and how fast trust is established. Our experience in China have shown that processes take longer time than in Western countries and the Chinese people can slow down the process in order to get their will through when negotiating. Theory in accordance to Harryson et al. (2008) highlight that it is important that the company representative to have great knowledge within the research field, otherwise the professor can try to sell the company already existing research results.

The easiest way might be to use the Technology Transfer Department in Tsinghua University in Beijing. The department will look for a matching professor and then it is up to the company and professor whether a collaboration project will be set up.
5.4 Company Support
Collaborations need to be handled with care provided with plenty of guidance since universities often are quite inexperienced in collaborating with Western MNCs. Our empirical findings suggest the company to educate the professor in how IP rights works so it can be owned jointly with the university. Other suggestions are quarterly review meetings so the professor and the project team can discuss problems and the company can give support and guidance. This outline also strengthens and maintains a good relationship. In line with Jansson et al. (2007) Chinese business environment theory Chinese people are more open if the relationships is good and trust is maintained. They are then more likely to address problems at an earlier stage.

Harryson et al. (2008) Chinese I-U collaboration theory address that the partnering company needs to follow up the Chinese professors work on a regular basis. The reason is to check that they really deliver according to the agreement and if nobody follows up, they may not deliver at all. Since Chinese people are used to be lead by others due to the hierarchy and do not question or take their own initiative the empirical study suggests Western companies to have a 50% employee for maintenances and monitoring of the project to make sure that the agreement is fulfilled.

In accordance to Hansson et al. (2007) Chinese Business Environment theory a business relationships starting with trust building and similarly Los Angeles Chinese Learning Center (2010) highlight the importance of strong relationships as the decisions are made subjectively. One way of building trust and create a good relationships is by support the collaboration is found from our empiric. Also the interviewed persons hold that a good collaboration includes support from the company in form of personal contact and time to discuss the problem. The more support they get, the more satisfying result will occur. We have also found that it would be good to learn the network work with each other as the empirical study also state. Putting some effort into workshops and relationship building within the network can be successful and affect the result positive in the long run.

The communication is according to the empirical findings very important and also the biggest challenge. Without good communication it is hard for the professor to find out
what the best result is and what research that is most suitable for the company. This process requires time. Allen et al. (2001) have in the Technological listening post theory claim that scouts can address many communication obstacles and can be used in a systematic approach.

The professors are in relation to the empirical study explaining and discussing with PhD Students and Master Students about the project. We find that it is better to bring in the students as soon as possible that are going to support the professor in the project into the discussion with the company. The challenge would be to get the students opinions and ideas since they are afraid of over-shine the professor and a separate workshop with the students can be thriving.

The empirical findings show that a good collaboration scenario is based on a long-term goal and the project expands every year with new interim targets. Also the Hansson et al. (2007) Chinese environment business theory suggests long-term collaborations and the research results would probably be better. Moreover relationships are built on long-term and so are Chinese business collaborations.

We find this as a good project set-up because the relationship will be stronger and thus a better result will occur. The initial stage and the beginning of a project require most time and guidance that the company need to invest in. To get return on the investment it is necessary to give guidance to the university until they are quite self going and the output will be bigger than the invested time and managing costs.

5.5 Horizontal- and Vertical Projects
The empirical findings hold that the universities got more funding from the government than companies. High ranked universities get most of the funding and do not need money from others in order to fund their researches. We have not got any numbers of how much funding companies give the universities, but indicators say that it is very costly for a company to collaborate with the top ranked universities.

Han, Industry PhD Student at Tetra Pak Packaging Solutions in Shanghai argue that high ranked universities are mostly suitable for them to work with since these universities have the best professors, best students and thus are best at research.
Lutz does not agree with this holding that other universities work as good as the high ranked and it is less costly. We agree with Lutz and find that universities that are not top ranked are more willing to collaborate since they need the money more, collaboration with a good reputation can also give the university a better reputation. Also professors seem to be more willing to adapt their research and they will probably put more time into the project since they are not that busy as the professors at high ranked universities.

Han (2010) explain in the Vertical and horizontal project theory that vertical research topics are edge cutting and mostly theory oriented. According to him the more publications that are produced during the project, the better evaluation the team will get in the final project review. In other words, vertical projects require time and effort. That is the reason why it is important to look into the workload between vertical and horizontal project to figure out how much time the professor have to put into a collaboration project with the company. If a professor is busy with many vertical projects there will not be enough time to generate good quality of work for the company.

The vertical projects are more important for the universities since they got more funding from the government which is strengthen by Han´s (2010) Vertical and horizontal project theory. Universities are competing with each other about these projects and it is prestigious to get desired projects to work with both for the university and the professor. Mostly it is SOEs that are behind the vertical project that the government announces. This is strengthened by the Vertical and Horizontal project theory by Han (2010) that holds that universities are bidding for the vertical projects.

A university can be doing project for National government and local government which makes it possible to work with many projects as well.

All respondents work with horizontal projects, but no one answered how the workload is divided between horizontal and vertical projects. They also state that the funding from horizontal projects is low compared to vertical project funding. In accordance to Han´s (2010) Vertical and horizontal project theory the average funding from National
Natural Science Foundation is 261, 50 million RNB. Even though some respondents do not want to discuss funding and horizontal projects they have now. They are more talkative when it comes to their vertical projects since they are very proud of these projects. This can however work as indicator for us to see how much time they can spend on other projects.

As shown in the Table 2, the universities in Shanghai are collaborating more with companies than those in the Beijing area. Tsinghua University is ranked as no. one and they have most Horizontal project of our researched universities. As found in theory universities in Shanghai area are popular to collaborate with, but also universities in Beijing. The only difference we can see from theory is that Western companies have more joint labs in the Beijing area than in Shanghai.
6 Conclusions and recommendations
We will in this chapter answer our research questions and conclude the major findings from the empirical study and the analysis. The purpose with this thesis is to explore how a MNC can build a network of local universities connection in a fast growing market and use this network as a source of technology scouting. We will finalize this chapter with general recommendations for MNCs planning or doing technology scouting at Chinese universities to succeed.

6.1 Conclusions

6.1.1 Sub question one

What universities do Western and Chinese companies use in China to Gain Technology Intelligence?

In our conclusions we have found that Western and Chinese companies mostly collaborate with high ranked universities in China. The reason is the societal hierarchy where the highest ranked universities have the best professors and thus the best students and research. It is very expensive to collaborate with high ranked universities and therefore only SOEs and MNCs can afford it.

High ranked universities got most governmental funding and other funding from companies is not needed. Consequently, universities that are not top ranked are more willing to collaborate as they need the money more and collaboration with a well known company can contribute to a better reputation for the university if they announce their collaborations. Professors are more willing to adapt their research and put more time into company based project since they are not that busy as professors at high ranked universities.

We have found that universities in the Shanghai area are collaborating more with companies than those in the Beijing area. Tsinghua University is the highest ranked university in China and has for example most Horizontal projects of our researched universities and hence less time to collaborate with companies. However, Tsinghua University has a Technology Transfer Department companies can contact and more easy get in touch with a professor doing research in the related area.
Companies have more jointly laboratories with Universities in Beijing area which means that they sponsor the laboratory and in exchange they can steer the research to the company’s field of interest area. In Shanghai it is more common to have collaboration with companies where the professors are doing a horizontal project. Our conclusion is that most Western companies having R&D units in China place them in the Shanghai area that is the biggest international centre of commerce in China. The professors in the Shanghai area also seem to be more industry driven than in Beijing.

However, in our conclusions we have found that it is not enough to only look at the universities ranking since it is the professors that are doing the company based projects and thus their personal interest of doing a project for the industry. Professors have either a theoretical- or an applying approach in their work. The easiest way of determine this is by looking at their produced papers and publications.

As shown in Table 3, the lower ranked universities are producing less publications/papers than the higher ranked universities except Zhejiang University. A professor doing applied theory does not have time to produce that many papers and publications as a professor with a theoretical approach. Professors that are doing applied theory are more likely to collaborate with industry since they gain knowledge and experience from project that can be beneficial or rewarding for them.

6.1.2 Sub question two

*How do Chinese and Western companies interact with universities in China to Gain Technology Intelligence?*

To interact with Chinese universities companies participates in conferences with the aim to establish a contact with a related professor. Another way is to use Western universities contacts or employees that have studied abroad at Chinese universities to introduce the company to universities.
Our conclusion is that Chinese and Western companies interact with Chinese Universities by collaborating with them in different forms. One way of doing it is to let them help the company to solve a specific problem by outsource R&D to the professor and the university.

Another way is to establish a joint laboratory in the campus and provide them with equipment and funding, as mentioned before the company can steer the research in return. Companies’ offer internship to students during summer holidays and a student working on a project can continuing doing that and as a result students will gain more knowledge and working experience and the company will get applications done and potential recruits.

Companies’ also looking for recruits at the universities and it is easy to employ a student already working with a horizontal project for the company. In that way companies get access to the former students’ network, alumni and professors, as the relationships last “forever”. Companies can hence tap these networks on information and find technology intelligence.

However, the process for finding the universities that is of interest for the company for collaboration always looks the same. First, companies looking for a collaboration start with the universities based on ranking, reputation and special research areas as some examples. Second, the university needs to have laboratories where the research can be done and finally a professor that match the company project.

6.1.3 Sub question three

How can Western MNCs establish and maintain networks to Chinese universities to get access to new technology that is originating from the universities?

To establish a network at Chinese universities a link between the company and university is needed. As suggested in the analysis, a Middle man that has connections and networks within the academic world is very useful. The most critical
for a Western MNC is to find the right Middle man that can open up doors to universities and professors, connect and present the company to important people.

The Middle man should have Chinese origin or at least have been studying and living in the country for a long time with excellence communication skills in the Chinese language. From our own experience it is almost impossible to get in contact without someone introducing you to the professor and a Middle man will save a lot of time for a company.

Figure 6 show a simplified model of the steps when establishing a collaboration starting with finding a Middle man. As mentioned before, once you are in the academic network, more doors will easily be opened. The Middle man can screening the Chinese universities in order to find the most suitable one, hopefully his or her personal relationships and contacts can introduce him to the related professor and link the company to the professor. Another critical step for the company is to establish a relationship, but if the Middle man is a strong link between company and university, this step will not be that hard.

As soon as a relationship is established the relationship building process starts with the professor. This step requires a lot of time and effort, but is a quite easy process.
Trust is essential for a relationship to occur and it is a time consuming process that every company that want to gain technology intelligence from Chinese universities need to work through. In order to build trust several meetings need to be done in order to get to know each other and to build up trust between the parties. These meetings require a senior manager to get respect from the professor and can be both formal and informal. The professors will probably ask personal questions in order to determine the other part’s societal status to be able to put the senior manager into right place in the hierarchy. Dinners and entertainment are the activities where the parties build up trust and thus a relationship.

When a relationship is established collaboration can be discussed. If the match between the company’s problem and professor’s research area and interest do not fit, the relationship can be fruitful anyway. The professor can introduce the company to other professors and even help to find a more suitable professor or university to collaborate with for the company.

When collaboration occurs, companies should have regular contact and personal meetings with the professors in order to maintain a good relationship. Professors seem to appreciate invitations to the company and conferences which shows that the companies paying interest to the relationship with the professor. The better relationship, the more information a professor is willing to give the company. In that way the company can get access to information about new technological breakthroughs and progresses, new research areas and information about what the professor is working with for the moment.

Our conclusion is that Chinese and Western companies interact with universities by having relationships with professors or researchers in university laboratories. These relationships give access to conferences in particular topics where new technology and research progresses are discussed. A relationship opens up closed network within the Chinese academic world for the company.

The Chinese use top-down mentality because of the hierarchical society and starting with the top will result in access to people below in the hierarchy. Saying that the company has discussed the project with a famous and high ranked professor will
make other professors interested if the research area that matches their field. The conclusion drawn from this is that it is important to choose the right university network in China because starting from the wrong end of the hierarchy can destroy the whole network building.

6.1.4 Main research question

How can Chinese Universities serve as a source of technology scouting in China?

Collaboration with a Chinese university makes it possible to tap new into technology from the premier state of the art researchers in the world. Our conclusion is that companies build relationships with Chinese universities in order to use them as a source of technology scouting. Information can then be exchanged between the parties and the company will get access to a huge network within the academic world. When a company is in, the networks are open and the flow of information is enormous. An I-U Collaboration with a Chinese university can result in that new technology is developed for the company and a special problem will be solved if it is project based. Depending on the size and length of the project a company can gain more or less knowledge from collaboration, but the best way is to establish a long-term based project. Companies that want to collaborate with a university in China need to establish and build up a good relationship which as mentioned before, is very time requiring in the beginning. Hence, a company will benefit more if they have a long-term collaboration with projects that are extendable and where new research is based on previous research. It will also save time because the professor learns how to collaborate with the particular company, what they want, how to act and what to expect. Also due to the cultural aspects communication and understanding for each other will be more developed since all companies have different company culture.

Another way to use Chinese universities as a source for technology scouting is to set up jointly laboratories at the universities as many Western and Chinese companies have done. The companies sponsor the lab with equipment and materials and in return the companies will get research result within particular areas of interest. This
seems to work out well if company monitors the laboratory in a regular basis to see that the agreement is followed.

It can be fruitful to keep in mind that professors do collaborate with each other and in our empirical findings we have found that professors sometimes apply for vertical projects together which means that professor can collaborate doing a horizontal project as well. A company should therefore also look at the professor’s personal network to see if it is possible to create a “project group” that will result in an even bigger network and thus more competencies and knowledge.

We have drawn the conclusion that using Chinese universities as a source of technology scouting can be very successful, but companies need to have in mind that is time requiring since Chinese is not self-driven and not always honest. If they see a chance to do ugly tricks that can benefit themselves, they are not afraid to take the chance. It is important to do the research on the university and related professor well before collaboration to make sure the professor do not sell already existing research. During the collaboration follow ups and regular visits is important as research results and data can be manipulated and Chinese are very united and hold their back, especially if it is their boss, in this case the professor. They do it in order not to ‘lose face’.

This model will illustrate steps that Western companies can use to secure collaboration with Chinese universities.

![Figure 7: Process of Chinese I-U Collaboration](source: Own)
Educate the professor in IP rights and make sure that it will be jointly owned by the company, professor and university so that the conditions will be good for all parties. Make sure that the agreement is understood right from both parties and outline it very clearly so no misunderstandings will occur. Before starting the project, the professor needs to be educated project management which the company has to do, but also the project group should be educated in project working. This takes some time, but our conclusion is that the project will run faster and smoother if they are educated in project working. Companies should not forget that Chinese are more used to work individually and not used to Western management.

When the project has started to run, it is essential that the company is monitoring the work and follows it up and gives feedback on a regular basis. However, the professor or the project group cannot get the feeling of being watched since it then will become an issue of trust that affects the relationship and thus the collaboration. When the project is done the company needs to maintain the relationship in order to continue with new projects afterwards or in future. During all steps the relationship is built up and if the collaboration is successful the relationship will become very strong. That is why relationship building is such an important step during the whole process.

6.2 Recommendations

Relationships

In China, relationships are the most important factor to succeed in the business world, especially within the academic world that is closed for outsiders. In order to be able to build up a good relationship we recommend Western companies to have a company representative working with relationship building and maintainer. Thus, a technology scouting unit should be established in China for more proximity.

It is time requiring building up and maintaining relationships and it is easier to have phone contact and personal meetings and representation such as dinners and entertainment. A person living in China will also learn how the society work and the Chinese way of doing and thinking, which is impossible to understand without living in
the country or staying for a long time. Another reason that is very important is that it is easier to monitoring projects outsourced to a professor by doing spontaneous visits at laboratories and the universities without being suspicious.

We recommend Western companies to use a Middle man originated from China that can open doors and introduce the company to important persons and professors in China. The Middle man can also do the university screening and can be hired as a consultant. Once you have met, you are “friends” in China and can from the first meeting act on your own and after meeting and established a relationship with those you want, the Middle man is not needed anymore.

Since the Chinese society is built on hierarchy it is vital to give the company representative that will become a key person a suitable title and a manager position, even if the position is fictive, Chinese professors need to believe that the company representative are high ranked in the hierarchy. To be able to discuss, the company representative need to have extensive knowledge within the research field in order to avoid troubles and dishonesty from the professor.

From experience and information from Westerners doing business with Chinese companies, it cannot be a person that is too young as the younger people shall show respect to elderly. Chinese people have respect to Westerners as they already have some respect to them due to their origin. A Western company should therefore use a Western looking person as their company representative to make it more credible. Hence, we recommend Western companies to find an employee with experience, excellence knowledge within the field of research, Western origin and not younger than 40 years old to succeed.

We recommend that the company representative should have a permanent long-term stay in China based on agreement. It is vital that this person do not leave the company and responsibilities. The reason is that Chinese relationships is built on long term and require plenty of time and effort. If a new company representative will take over, the old representative can only introduce the new one, but the relationship will start over from the beginning. Thus, the company representative need to be picked out very carefully and should have been working for the company during a
longer time with experience from the research area and well familiar with the company culture. The company representative needs to be very flexible in mind, easy to adapt to new conditions and cultures, patience and a good networker of course.

We recommend Western companies to employ a Chinese assistant to the company representative. The assistant can “educate” the company representative in Chinese culture, history and behavior. During meetings the assistant will work as a translator, but also read body language and observe the surroundings. From our own experience, professors are not that good in English and misunderstanding can occur quite often. Information given in Chinese will be correct and more detailed as the professor will feel more comfortable speaking his or her own language.

Hence, the assistant need to have knowledge within the research field and should at least have engineering background. We recommend Western companies to use a younger Chinese as assistant. A younger person is more adaptable in mind and easy to learn and educate, besides that also more loyal to the boss and not that expensive to hire as an older more experienced person.

Collaborations

We recommend Western companies to carefully evaluate what kind of collaboration they want to have by clearly defining the purpose and aim of it. We suggest Western companies to not forget lower ranked universities since they are more likely to adapt their research and way of working than a high ranked university in China. It is cheaper to collaborate with a lower ranked university and the professors having more time to put into horizontal projects. They are also more interested in horizontal projects and have a more industry driven approach. However, the top-down hierarchy do that it is necessary to always start looking at the top before contacting lower ranked universities in China. We suggest Western companies to contact or visit the highest ranked universities in China first as the lower ranked will open their doors if they know that the company have been at the top universities before. It is flattering for the professors that a well known company with a good reputation is interested in their research when they can collaborate with the “best” professors and universities.
It is important that Western companies’ show that they are willing to adapt to the Chinese way of doing and that there is willingness to invest in the collaboration. We recommend companies to listen to the project group and to accommodate them with support.

We also recommend collaborations based on long-terms since the invested time and money for relationship building in the beginning will be returned and thus, more wisely invested. Western companies collaborating with Chinese universities should take the monitoring part of the collaboration seriously and also require that research data is saved, to make sure that the results is not manipulated. For jointly labs, monitoring should also be done in order to ensure that the agreements are followed.
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