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Chinese Innovation Research to Industrial Transformation and Upgrading

Processing innovation in case company

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SYMBOLS AND ABBREVIATIONS

CPS	Cyber-Physical Systems
GDP	Gross Domestic Product
ICT	Information and Communication Technology
IoT	Internet of Things
IoS	Internet of Services Technologies
IT	Information Technology
R&D	Research & Development
ROI	Return on Investment
SMEs	Small and Middle size Enterprises

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ABSTRACT:

China was famous as world factory. Most small and medial size Chinese industry are facing the industrial transformation and upgrading stage. Innovation level as a competitive competence is extremely important to manufacturing. However, sophisticated technique and radical innovation skills are still blank in level of SMEs. The thesis will focus on solve innovation dilemma in SMEs, that Chinese SMEs prefer incremental innovation rather than radical innovation, and radical innovation cannot occur in large scale. There are some barriers that impeded Chinese innovation had also been discussed. To clarify the barriers helps industry easier innovate than before.

Research will combine both quantitative data analysis and qualitative data analysis to explore three questions. Quantitative data observed from case company. By using statistical method, correlation between data can be recognized. Qualitative data received mainly from a talk interview. This interview organized by Chinese official television station. Business network relationship reports and journals are the second main resources for qualitative data analysis.

The thesis will indicate that Chinese SMEs prefer slow innovation has historical reason and quick profit desire. Number of innovation might have no different between big companies and small companies, but big companies have more resources to do radical innovation than small ones. All action bonds within business value net are somehow affect innovation development in China. A efficient collaborative networks with each action bonds can help to increase the innovation level.

KEYWORDS: Innovation, Business network management, Process efficiency.

1 INTRODUCTION

1.1. Research motivation

The topic of this thesis has been changed for several times. The concept of thesis comes from small and middle size enterprises (SMEs) industry in south of china. It is a manufacturing company of spare and accessory parts for international construction machinery and equipment enterprise and other similar companies. The business scope of the target company is processing with imported materials, processing on giving materials, assembly operation and processing of semi-finished products. The research topic of the company was high dependence of labor experience, significant produce error variance due to obsolete tools and equipment and disordered manufacturing schedule.

This thesis changed to analysis and explores an innovation concept since news has been read" What a ball pen tells us about China's manufacturing weakness." (Ko 2016). Premier Li Keqiang made a press conference revealing the industrial capabilities of China on national television. He pointed out to a ball pen manufacturer that when Chinese ball pen is able to produce as good as German pen.

After some relevant documents have been read and a level of basic research, there is an idea which combined innovation into industry efficiency. Companies always require innovation when they are facing the industry transformation and upgrading stage to improve the industry efficiency. However, the fact is the country can produce everything from iPhones to artificial satellite, can produce more than 40 billion ball pen annually occupied 80 percentage of worldwide business(Li 2016), but China only be labeled as the "world's factory"(Xu 2016). The most profitable component, the most sophisticated technique and the most radical innovation skills are still missing from Chinese technology handbook.

The key component, metal balls and nib of the ball pen, as a special metal, has to be imported from overseas suppliers. *"Producing the tiny rotating ball fitted to the tip of a ball pen has turned out to be an insuperable hurdle for Chinese manufacturers"* (Worstall 2016). Lack of high value technology, core innovation and key competitive strategy led to Chinese industry struggle in low profit business.

The thesis is made to draw a general view of Chinese manufacturing with innovation activities. Meanwhile, it is also wishes to help Chinese industry transformation and upgrading in the future.

1.2. Research question

Before resolve a question, the problem needs to be identified. The motivation of exploring innovation in China brings three questions which are the basis of this thesis research. These three questions has been listed below that they were set from both internal and outsider's perspective. Consumers who are not familiar with Chinese manufacturing will confuse the real status of Chinese innovation status; who are inside the Chinese manufacturing will lost further direction when facing industry transformation and upgrading stage. These questions help them to discuss the possible innovation strategy in further development.

Q1: Why Chinese manufacturer prefer a slow change innovation process rather than radical innovation process under present situation?
Q2: Does middle and large size companies do more radical innovations than small companies?
Q3: What are barriers of Chinese innovation revolution?

In fact, the question asks a general surface of innovation and technology in China. Comparing with big size company, innovation in SMEs is more specific of assessing entire innovation level. Questions involve historical background of technology innovation, managing innovation and relationship network outside innovation.

Statistical data analysis of empirical data from case company and qualitative data collected from journal and media will be used to answer the questions.

However, since the empirical data received from production process and the case is based on process innovation. The researches might limit in process innovation and describe a general framework of innovation in China.

1.3. Structure of the thesis

The thesis has been divided into five chapters on account of exploring three questions from different perspectives and involved variance concepts. The start of the thesis will be the introduction and description of thesis motivation. Significant research questions and structure of the thesis also be introduced in this chapter.

The second chapter is followed with literature review which involving historical background of industrial innovation revolution between Western country and China, managing innovation topic, and concept of business relationship management.

Comparative studies of the industrial revolution history of the two disparate societies might help to get a macroscopic view of differences between Western country and China. The concept of innovation content will simply describes the innovation definition and also Enumerate innovation types and levels. To imply the industry improvement, innovation process and relevant problems are required discussion in this chapter. Business net value, The ARA model, co-operation and co-opertition concept will be introduced to indicate the innovation relationship from outside of focal companies. The relationship perhaps is the reason which impact Chinese innovation in general.

After that, in research methodology chapter indicate the research plan, research data, research methods and limitation of research. Research data analysis and discussion chapter will combine obtained quantitative data and qualitative data with research questions to reveal answers of innovation.

Final conclusion helps to summarize previous research result and present the answer of previous questions. The result drew a general innovation status, as a reference, for groups who are interested in Chinese innovation actuality as. It is also wishes to help Chinese and other developing industry when they facing the stage of transformation and upgrading.

2. THEORY AND BACKGROUND KNOWLEDGE

2.1. Historical background between western countries and china

"Rome wasn't built in a day"

This medieval French adage expresses that creating any immortal things request unremitting efforts for a long time. Industry needs to be developed by means of several revolution of technology innovation. The production method from hand production methods to machinery methods, and even digital methods in 21centril of human beings also adapt miracles and failures. However, innovation of technology was not born with talent. It takes time to development.
In order to analysis the innovation level of China, the comparison between Chinese industrial revolution and Western countries industrial revolution should be considered.

2.1.1. Western country industrial revolution

European countries, or Western countries for Chinese people, had totally passed three times of industrial revolution. The first revolution happened from about 1750 to about 1840. During this time, the production methods of human beings improved from handmade production methods to machinery methods.(Hudson 1992: 11-15) There are several technologies has been developed during this revolution, typical was famous in textiles (Ayres 1989:16–17), Steam power and Iron making (Bond, Gingerich, Archer-Antonsen, Purcell, & Macklem.2003). These innovations of machinery had dramatically changed further industry generation.

The second industrial revolution happened between about 1870 until the beginning of the 20th century. (Engelman 2015)This revolution also named as the technological revolution, which indicates that technological innovation had rapidly spread in industrial field. After European countries, the United States and Japan welcomed a dramatic development of industry. During this period, the invention and application of the electric power led to the rise of several diversified industrialization. Since that time, Western countries own more than 80% of global industrialization. Until 1900, American owns 24% of global industrial business, and European totally occupied 62% (Bairoch 1982:12-14).

The third industrial revolution means digital revolution which since after the Second World War till the late 1970s with the innovation of digital technology affecting impressively to resent life status. Comparing with mechanical and electronic machinery, digital technology increase automatic and efficiency and decrease the costs and failures.

A total new concept has been published by German government (Takano 2014; Schwab 2016), industry 4.0 in 2012, which also been indicated as the fourth industrial revolution. The variance of concept of this revolution does not create new industrial technology, but a vision of smart factory (Germany trade & invest) which executes a collective technology in terms of correction between manufacturing technology, product information and database correlation. Combination of Cyber-Physical Systems (CPS) (Hermann, Pentek & Otto 2015), Internet of Things (IoT) and Internet of Services technologies (IoS) for building a more adaptive, effective and human manufacturing environment, further influencing business value chain organization (Mulholland 2014; ABB).

2.1.2. Chinese industrial revolution

Apart from previously mentioned technology innovation process, disparate industrial environment in the early age of China had influenced Chinese technology development into different direction. The emperor in order to stabilize the regime of Chinese empire system, an imperial examination system (Crozier 2002) has been structured to assess competent people to help control the empire. The exam context of imperial examination system is based on Confucian classes and similar literature study. After the exam, people will be segment into different hierarchical class and be allocated different social resources. The government holds the property division, people's private property rights has not been fully respected. Even though China have the basis for industrial revolution in the early years of the Ming dynasty, however, based on variance resource allocation system, industrial revolution will never initially happens in China (Bao 2010).

Chinese industrialization is significantly developed since the 1950 s. A campaign named “the Great Leap Forward” was led by Chairman Mao and aimed to rapidly upgrading the country. The purpose of the campaign is the government wishes country transform from an agrarian economy into a socialist society through rapid industrialization and collectivization. Since that time, Chinese industry focuses on rapid GDP (Gross Domestic Product) increment. In 1965, the GDP of china was 171.6 billion (RMB). After 13 years, in 1978, the GDP has dramatically increased until 362.4billion (Chen 2014; Li 1984:23-31).

After 1978, China went to a new stage which also named “The Chinese economic reform”. This campaign means reform and opening stage for Chinese industry launched by Chairman Deng. During this stage, Chinese economic system shifted from planned economy to market economy, and encourages individual and sole proprietorship start own business. Until 2005, the Chinese GDP arrived 18232.1 billion (Fang, Park & Zhao 2008).

After Germany embarked on industry 4.0 revolution, Premier Li also launched Chinese new industrial revolution campaign named: Made in China 2025. In this official notification, Chinese government indicates the weakness and opportunity for Chinese manufacturing, for instances, Chinese manufacturing still has a gap with developed countries and the skill of self-innovation is weak, but industry scale ranked first in the world and China built an independent and complete system of manufacturing (The State Council).The government give a chance to transform and upgrading Chinese industrial system.

2.2. Managing innovation

2.2.1. What is innovation?

The process of translating an idea or invention into a good or service that creates value or for which customers will pay (Business dictionary). Innovation is a process that brings an idea, an invention and completing the development and exploitation aspects of new knowledge into realistic use. Innovation capacity also has been seen as a power of securing competitive advantages in strategy level of companies. But, is innovation just one way? How can we manage innovation? Exploring innovation management in more detail provides the basis for the rest of this chapter.

2.2.2. Types of innovation

Since the definition of innovation, not only the product can be innovated, but also can bring new technology into manufacturing process. To expend the types for innovation, 4Ps approach has been introduced by Tidd and Bessant (2011:19-26) in their famous book. Four opportunities dimensions have been listed to create different.

Four broad categories:

- Product innovation: This innovation involved tangible product and intangible service changes that offered by organizations. Product innovation can base current product to improve quality, or bring a totally new concept of product into market.

- Process innovation: Innovation of process changes in the ways of offer created and delivered. Process change improved industry operations efficiency through upgraded equipment. Moreover, process can be improved from different perspective, for example, Internet used in traditional business.

- Position innovation: This innovation may like old wine in new bottles, the existing products and services changes the way they used to have. Position changes can explore a vast customer from existing product.

- Paradigm innovation: Paradigm changes the frame of work. It is an underlying mental model of doing business is the concept of this innovation. Different with previous innovation, it innovation restructure current business.

Sometimes, innovation cannot be segmented specifically into previous four categories. There are some innovation are somewhat blurred, that could be both a position innovation and product innovation. Fortunately, any kind of innovation can expend a wilder business somehow.

2.2.3. Scope for innovation:

Innovation is a process that brings different types innovation comes true. However, these innovation sometimes are completely new in the market, sometimes are derived from existing market. “*Innovation is not just about opening up new markets- it can also offer new ways of serving established and mature ones*.” (Tidd et al. 2011). An innovation happens in a region between incremental and radical changes.

Radical innovation is dramatically changing process aimed at meeting the needs of customer though understanding of previous market and challenging for radical innovation in new area (Tidd et al. 2011:165-174). Comparing with incremental innovation radical innovation avoids strong competition in existing market but facing a vast population of underserved market. From strategy point of view, radical innovation is also named innovation leadership strategy. This strategy is used when the company's target is the first of the market which based on technological leadership. This innovation requests a strong creativity to combine own competitive advantage with new knowledge, and to the needs and responses of customers.

Incremental innovation is improving processes based on current production through sustained increase of quality and productivity thus made an innovation learning curve. Continues improvement of this upon companies’ continues incremental problem-solving innovation which combines with introduction of new production and process (Arrow

1962:74-155). Hollander (1965:88-92) in his study suggested that cumulative gains in efficacy are often getting a better result over time than those which come from occasional radical innovations. Innovation followership is the name of incremental innovation in strategy perspective. It is the company chooses to learn the production experience from technological leaders, to follow the step of technological leaders and to avoid risk and uncertainty from innovation activities. This innovation aim at market share, cost saving and competitor analysis.

After combine the innovation types with scope, a framework (see Figure 1) of innovation space has been draw by Francis & Bessant (2005). They suggest this framework available to any organization. This figure indicates incremental and radical innovations are not two extreme cases. Innovation could be operated between the ranges of that (see Figure 2).

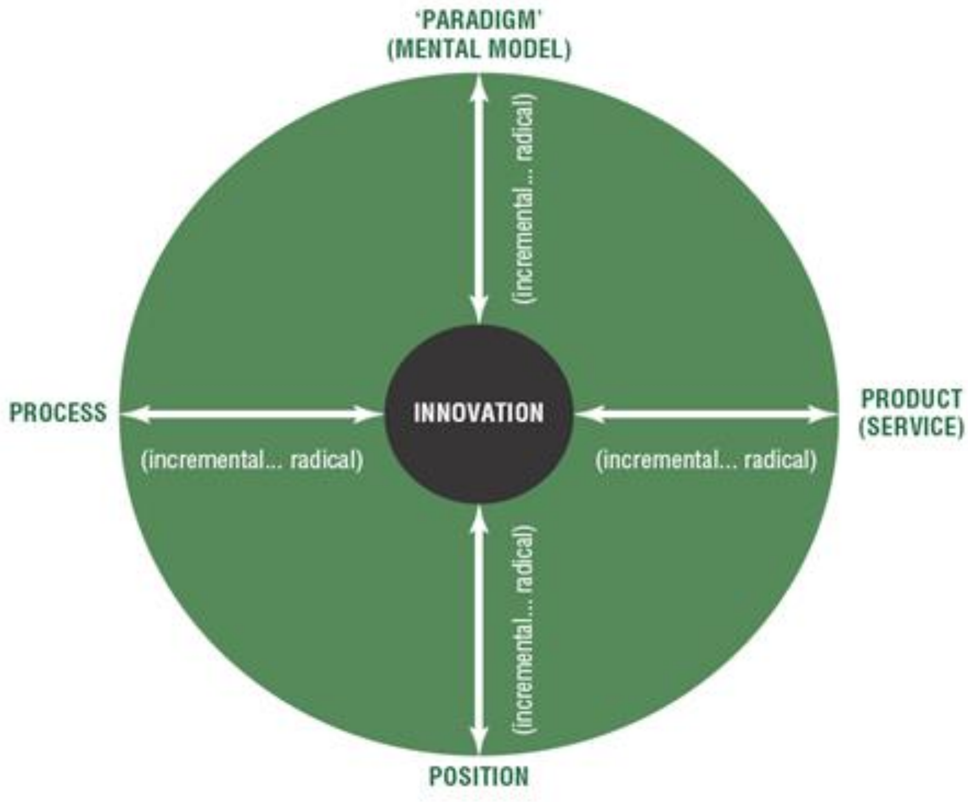

Figure 1. The 4Ps of innovation space. (Tidd et al. 2011:22)

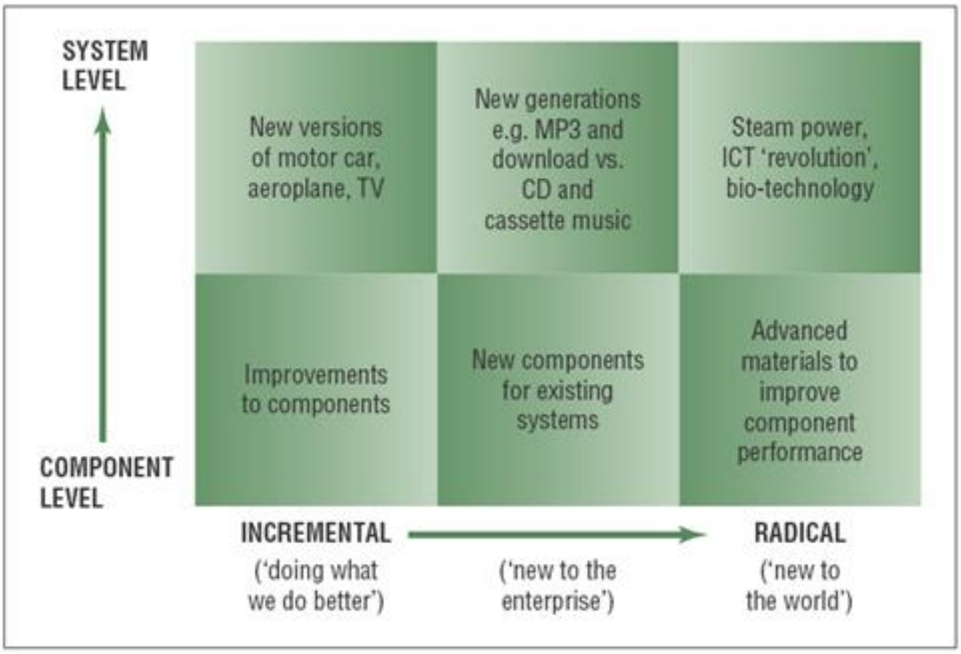

Figure 2. Dimensions of innovation (Tidd et al. 2011:38)

2.2.4. Innovation process

There are four key phases used in organizing innovation process, each of which requires dealing with special resources and particular challenges- and only if we can manage the whole process is innovation likely to be successful. These four key phases' model are involves search, select, implement and capture (see Figure 3)

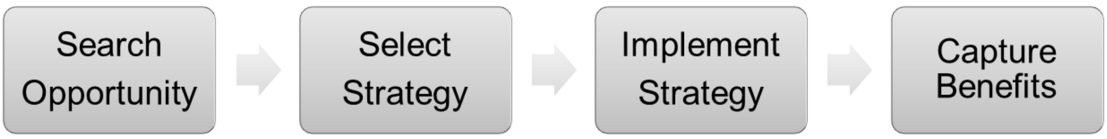

Figure 3. Simplified model of the innovation process

Search stage started from an initial idea that how the company can be improved? The ideas can come from itself research and development (R&D) department, competitor, customer and any trigger that companies willing to organize a more effective manufacturing by bring new ideas to the system.

Select stage followed by previous brainstorm research. In this stage, company need to consider some realistically issue calmly. This process requires taking into account of competitive strategy and differentiation of manufacturing. The choices should be the best chance of standing out from the crowd and considering previous capability that the risks of innovation can be afford by company.

Implementation is the stage to bring selected innovative strategy into reality. However, even the target has been set; there still have many challenges under the process. In this stage, essential task is to manage a growing commitment of company resources against a background of uncertainty (Tidd et al. 2011).

Capture the innovation and receive the benefit from the changes is the meaning of this stage. But although all innovation projects have been finished in this stage, they are not always satisficed by organization. To find out the adaptive innovation and to learn from the change is the basic of future innovation

2.2.5. Innovation problems

Most innovation had been operated with a level of understanding of risks; innovation process model is made in order to avoid those unnecessary risks and uncertainty. However, occasional issues may destroy the innovation during process.

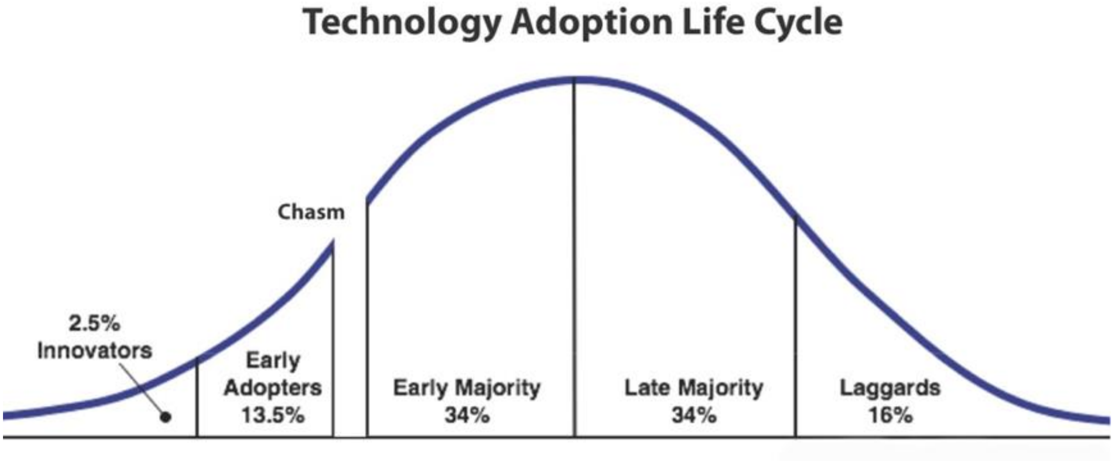

Figure 4. Technology adoption life cycle (Moore 2015: 83)

Figure 4 is the famous picture illustrates a gap of innovation adoption at early stage. Most technologies will fall into this chasm and fail the adoption. Innovation process may also face this chasm during Implementation stage. During this stage, company resource and reality status will be considered into Implementation. Once conditions of innovation have been changed it is better to rethink the project again.

There are some triggers, such as new technology, new political rules, and new market emerges, will affect innovation process into uncertain place. These triggers perhaps shorter the process, but might also vice versa.

2.2.6. Conclusion of managing innovation

Innovation types and scope provides capability to manufacturing to extend current business scope, improve technology structure, and bring befit into industry. Different innovations have specific features which responding changes in different circumstance. Innovation process illustrated a simply why how innovation can be managed from theory into reality. Flexibility and adaptability is requested from the beginning of the process. However, there is still has many occasional events might cause the failure of innovation. Though the innovation has been captured by organization, it is only a base of future changes. Innovation is a process.

2.3. Innovation related business relationship management

Innovation cannot be finished by one person. A network of innovation has been indicated as great ways of creating a possible environment of invent new products and process. (Jaikumar 1988; Williams 2004). However, considering the situation of Chines industry, the research in this thesis is more focus on dynamic relationship around a core company. A business network relationship introduction starts from extension concepts of relevant theoretical foundations.

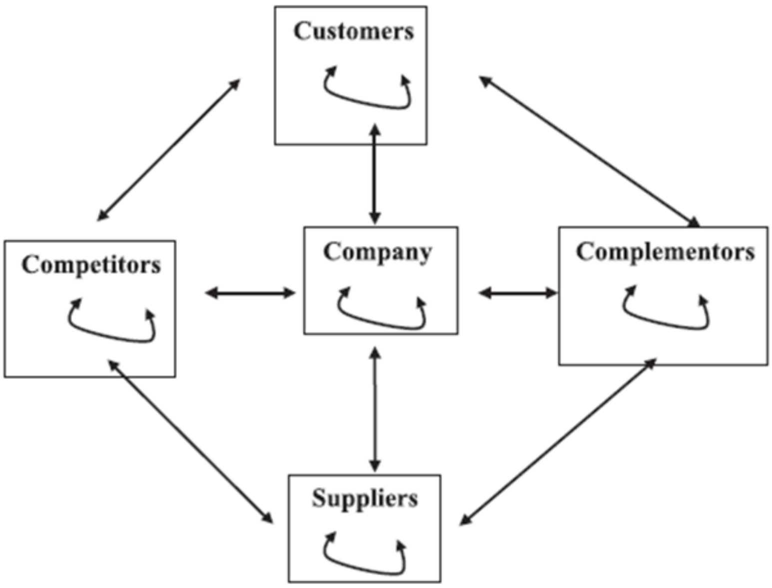

Figure 5. A firm's value net (Brandenburger et al., 1997)

Analyzing a relationship around inter-organization sometimes start from identification of focal company. In carrying out business activities, a focal company may develop relationship with various types of firms and other types of organizations because they affect, directly or indirectly, their performance. A network involves the focal company and other organizations, which have tangible and intangible activities with focal company. Brandenburger & Nalebuff (1997) structured a model formed with four types of firms and organizations, which also named as value net, that affect a firm's ability to produce and deliver value to target customer. (see Figure 5) illustrated a firm's value net.

The value net identifies four types of firms and organizations which are suppliers, customers, competitors and complementors. (Ritter, Wilkinson & Johnston, 2004:175-177). One reason of doing the value nets analysis is a clear dynamic network structure can be able to illustrate. The intensive degree analysis was also suggested to analysis the value net of focal company in the order of identifying a firm’s product ability (Ritter et al., 2004:175; Gadde & Snehota, 2000:308). From innovation point of view, other organizations’ strategies and activities also influence innovation strategy of focal company in this dynamic network.

The ARA model was found by Håkansson & Snehota, (1995), presents intensity and behaviors between level of involvement, influencing factors and used to constitute a business relationship to discuss the critical processes that underlie the formation of relationships. The ARA model consists of three elements which are resource ties, activity links and actor bonds. The model relationship affects innovation performance somehow.

Besides the concepts of value nets within dynamic networks, network capabilities also affect competitive advantage creating, which refers to the ability to build, develop, handle, and exploit network relationships (Ritter & Gemünden 2003:745-755; Capaldo & Petruzzelli 2011:273–286). According to Vesalainen & Hakala (2014: 930-950) in the partnering logic, the network capability relates to joint value creation, learning with customers, participating customers' processes, adapting to customers' needs, close relationships with customers. The role of these capabilities may play a core competence, a core capability, a dynamic capability or a part of company´s strategic capability in the company. Network capability consists of personal competencies, which includes development oriented resources distribution, activity interaction, communicate, cooperate and value creation, and consists of organizational competences and capabilities, which indicates strategy oriented resources allocation, specialization, internal competitive recognition, investment, reliability and flexibility.

Since the understanding of network capabilities, organizations could collaborate in order to get fresh resource, to innovate, to learn and to save costs by performing functions together (Walter, Ritter & Gemünden, 2001:365-377; Chetty & Blankenburg, 2000:77-93). This leads to the next concepts of value co-creation (Myllärniemi, Vuori, Helander, Ilvonen, Okkonen, & Virtanen 2013) and multilateral co-operation (Varamäki & Vesalainen, 2003:27-47). Figure 6 illustrated different types and assumed outcomes of multilateral SME co-operations. The value co-creation interaction patterns actively initiate by both focal firm and other actor bonds together. The value means business operate between benefits and sacrifices, it created and developed with business relationships and networks. The value was divided by direct and indirect functions that direct value functions are profit, volume and safeguard, and indirect value functions are innovation, market, access and scout. Alone with joint value creation processes, multilateral co-operation with all players in this networks required creates and achieves value leading to value co-creation.

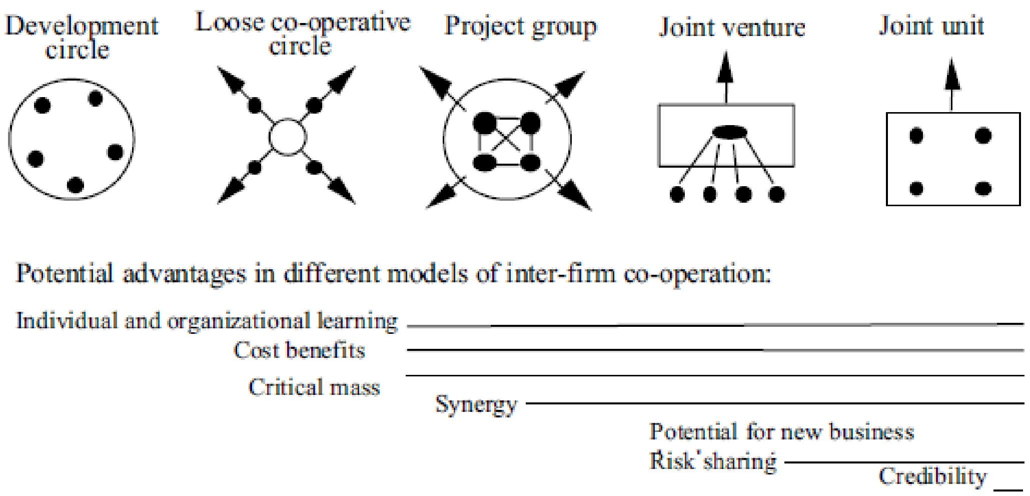

Figure 6. Different types and assumed outcomes of multilateral SME co-operations. (Varamäki & Vesalainen 2003:34)

Whilst a complexity arises from many sources, actors and activities, product or service complexity is increasing risk and barriers in business networks (Harland, Brenchley &Walker, 2003; Ahokangas, Alila, Helaakoski, Kyllönen, Lehtimäki, Peltomaa, Seppänen, & Tanner, 2015: 87), such as country and culture differences, standardization, Coordination and communication problems and conflicts reflect in financial, performance, social, time and physical losses for a company. As well as the switch risk from cooperation to competition between two dyadic companies, coopetition strategy (Tidström & Hagberg-Andersson, 2012; Tidström, 2014) refers to find a balance between transformations. Coopetition strategy simultaneous existence of cooperation and competition, which core competencies are protected and sharing knowledge be balanced. Studying the coopertition are benefits (Bengtsson & Kock, 2014: 178-194) to increase competitiveness and competitive advantages, innovative development, exploration of opportunities and resources.

3. RESEARCH METHODOLOGY

3.1. Case description

The case based on personal summer training project. The case company is not only a manufacturing company of spare and accessory parts for international construction machinery and equipment enterprises, but also manufacturing spare parts for other companies. The business scope of the company is internal processing on giving materials, processing on giving materials, assembly operation and processing of semi-finished products. In other words, the company purchase or accept customer's materials or semi-finished products for processing operation.

3.2.Research tools

The quantitative data required for statistical analysis by using statistical software SAS Enterprise Guide (Leslie 2013). Since the data which received from case company need to be analyzed to find an efficiency relationship within each operation. This statistic tool will efficiently present the distribution of data and correlation relationship between different data.

Qualitative data analysis used four stage of data analysis (see Figure 7) as research tool (Quinlan, Babin, Carr, Griffin & Zikmund 2015:330-334). The qualitative data will be described at the first stage and be interpreted in second stage. During the second stage, data will be transcoding into meaningful evidences. In conclusion stage, uncovered data will be collected into certain group in order to suit particular research questions. The final stage of theorization approach usually combining the theoretical framework with current work to contribute future research.

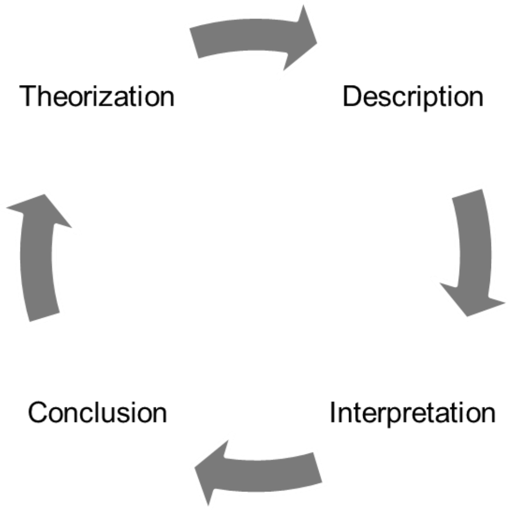

Figure 7.The four stages of analysis

3.3.Research design and data receive

At beginning, the research plan was made to improve the manufacturing efficiency before the data was collecting, however, the empirical data which was collected also helpful to the research questions. There are three research questions refer to manufacturing efficiency and policy issues that will be explored by both quantitative data and qualitative data together.

3.3.1. Quantitative data

Quantitative data was collected from a processing on giving materials production line. This production line requires to cut a size of 3.75*1 m steel plate into .a 0.7*1m steel sheet, which means one steel plate needs to be sliced into five pieces and with extra waste. 100 pieces of steel plate are being measured to indicate question one of innovation level. 100 pieces of steel plate are being measured by following way of excel (see Table 1).

Table 1. Processing time record

setting	cutting	setting	moving	second move	
143	153	47	145		1923
	155	54	60		
139	129	60	59		
	140	42	113		
	124	43	126	191	
298	133	36	97		2104
	125	40	55		
223	130	60	62		
	147	50	78		
	120	44	160	246	

The quantitative data required for statistical analysis by using statistical software SAS Enterprise Guide. This statistic tool will efficiently present the distribution of data and correlation relationship between different data. Figure 5, Figure 5 Figure 6. Are samples of data correlation distribution, more explanation will be presented in following chapter.

Table 2. Pearson correlation coefficients between operation time and total time.

Simple Statistics						
Variable	**N**	**Mean**	**Std Dev**	**Sum**	**Minimum**	**Maximum**
Operation	100	912.61000	35.21963	91261	840.00000	1024
Total time	100	2055	191.40216	205511	1745	2902

Pearson Correlation Coefficients, N = 100 Prob > |r| under H0: Rho=0	
	Total time
Operation	0.20052 0.0455

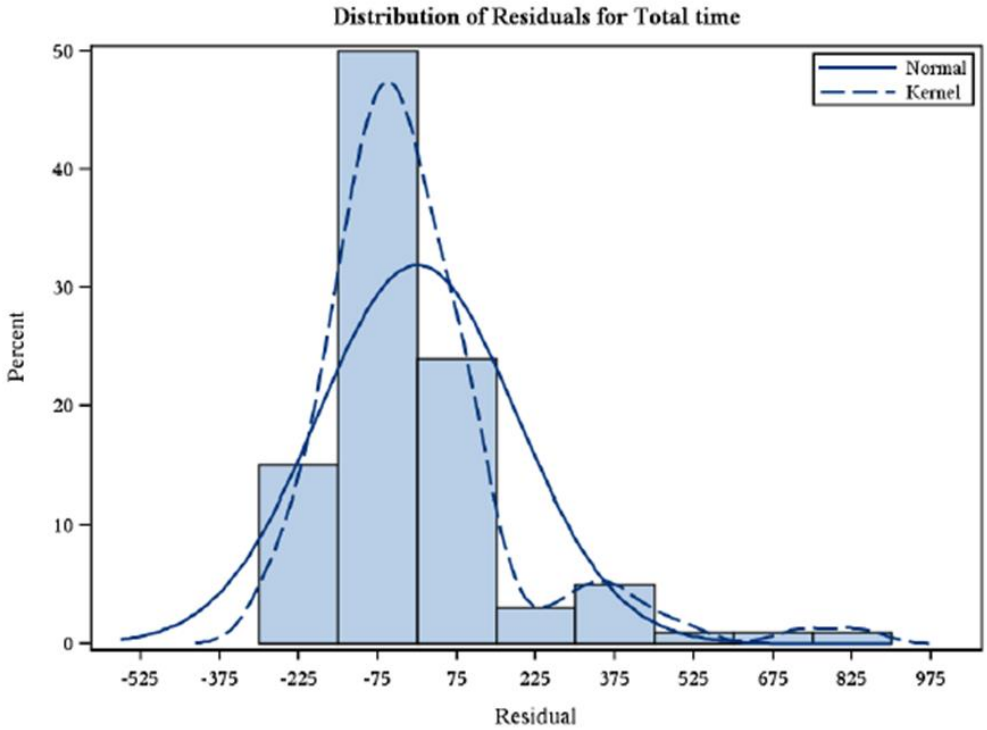

Figure 8. Linear regression between operation time and total time

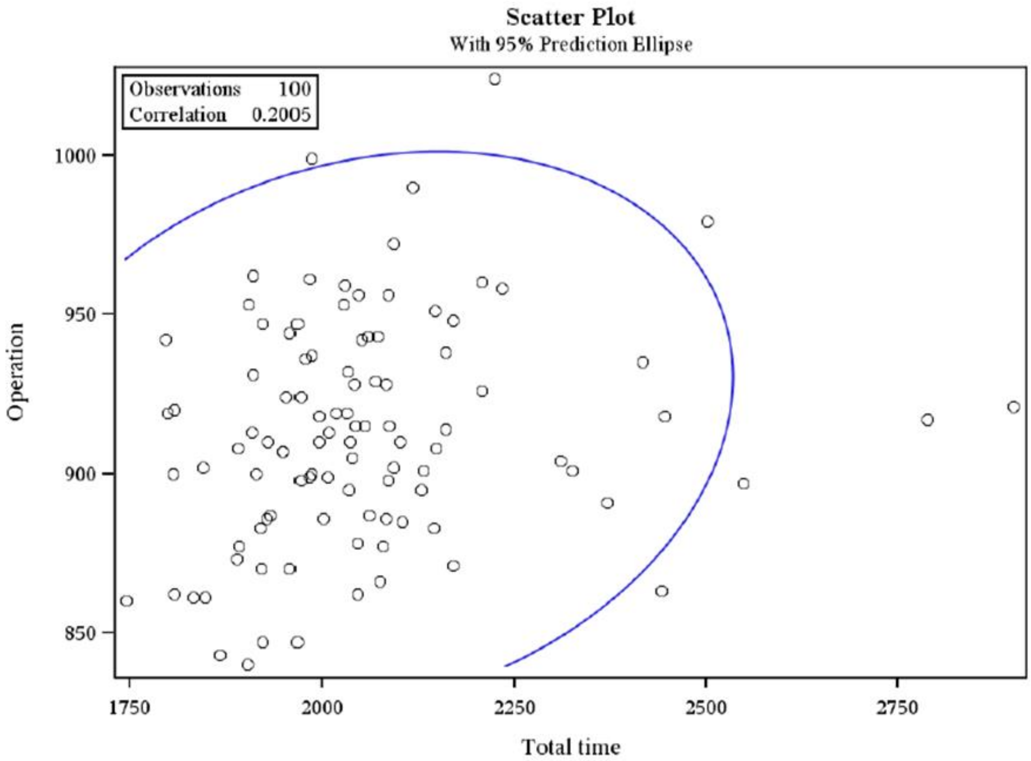

Figure 9. Scatter plot of correlation between operation time and total time

3.3.2. Qualitative data

Qualitative data analysis is use to answer question two and question three. One important data resources come from a talk interview (CCTV Finance Official Channel 2015). This interview introduced basic industry status of China and indicated several relevant problem of innovation in China. Three interviewer and one industrial stakeholder were been interviewed. There are Dong Mingzhu, chairman of Gree Electric Appliances Inc., Qu Daokui, president of Siasun Robot & Automation Co. Ltd., Guan Xiyou, chairman of Shenyang Machine Tool Co., Ltd., and Qiu Zhiming, chairman of Beifa Group Co. Ltd. The interview will be reorganized by four business net value and presenting an internal relationship between this network (see Table 3).

Table 3. Qualitative data of interview classed by business net value

	Dong Mingzhu	Qu Daokui	Guan Xiyou	Qiu Zhiming
Competitor	Self-innovation is the only way to exceed others	Industrial system is not standard, low price strategy	Technology plagiarism between competitors limited motivation of innovation	Some companies used anti-dumping reasons to control low price strategy
Complementor	Cooperator Industrial collaborative is required.	Lack of spirit of contract. Business cannot be controlled under standard rules	Big cooperator squeeze small companies' profit	Government is not support small factor which limited innovation in a large scale
Supplier	Materials from supplier need to achieve companies' quality standard	Found possible supplier from world wide scale. Buying materials and machines and also cheaper than others	Avoiding supply stick, Building a health supply chain system. Do not finish all component by ourselves	Requiring high-technology raw materials from supplier.
Customer	Customer want appearance design more important than technology innovation	Customers are not expecting high tech product	Customer occupied more innovation motivators than focal company	Compare with high technology innovation, customer want cheaper product.

There are many reports and journals from business relationship management theory are also used to collect necessary qualitative data. Materials come from Business Network Management course and electronic data base from library of University of Vaasa. All data will be segmented and in order to answer different research questions.

3.4. Limitation and reliability

Generally, a research project used a sample size of data to deduce a popular size result. Under a strategy calculation between sample size and popular size, the result accepts a degree of variance between data size. The deviation of reality can be listed in different dimensions.

Firstly, the empirical quantitative data of manufacturing efficiency was collected from the case company. The data limited to explain the case company’s efficiency. Then, the empirical qualitative data was collected from the case company and similar companies in the same geography area. Thus, the result of the analysis depends on the information provided by the owner of companies. In addition, even business relationship management has been recognized for a long time, business network management utilization still fresh in manufacturing. Especially, the scope of research project relevant with customer’s strategy and government’s policy will potentially made a big deviation between different companies.

4. DATA ANALYSIS AND DISCUSSION

This Chapter will continually discuss and analyses the data which have been received from case company and talk interview. The analyses are classified according to three different research questions; each question presents relevant data and discussion. Final result will be summarized in conclusion chapter; hence, there is no comprehensive result in the end of this chapter.

4.1. Question 1: Incremental innovation with radical innovation

Why Chinese manufacturer prefer the incremental innovation rather than radical innovation in recent period? This question can resolve from two perspectives which are historical reason and innovation strategy choose.

In Chapter two, comparison of innovation revolution between western countries and China has been introduced. Western countries experienced tree times of industrial transformation and upgrading development since 1975s.The first industrial revolution used water and steam as a source of power, the structure developed from handmade industry into machinery industry.

The second industrial revolution innovated electricity became a very famous power and support to mass production. The third industrial revolution developed into use of electronic equipment and information technology (IT) to enhance the automation of industrial manufacturing. The revolution of industry goes through more than 200 years to eliminate the influence of human and achieve a high level of technology structure.

Chinese industry exploded since a campaign in 1950 s, it is named “the Great Leap Forward”. Chinese new government recognized a national backward economic and industry, therefore, the campaign hold to develop national industry from a handmade stage. After 1978, Chinese government launched a new campaign, also as a new policy of Chinese industry strategy, which named “The Chinese economic reform”. The new policy encouraged industry spread its scope and extend the diversity. China considers developed countries a model industry, after around 60 year’s times, Chinese Gross domestic product GDP only ranked after United States which achieved 10,354,832 millions in year 2014 (World Bank 2016).

Table 4. Comparison of industry revolution history between western country and China.

	Western Countries	**China**
Around 1750s-1840s	The first industrial revolution Machinery industry	Handmade industry
Around 1870s-1920s	Second revolution Electronic industrialization	Handmade industry
Around 1940s-1970s	Third revolution Digital & automatic industry	Great Leap Forward Machinery, Electronic & Automatic
After 2010	Industry 4.0 smart factory	Made in China 2025 Industry transform and upgrading

Table 4 was made to present a history of industry revolution process. Innovation is a process that requests a long time development from zero to one. Chinese industry set a target of achieving modernization of science and technology in the shortest time; otherwise it will lag behind other nations. Figure 8 present regional GDP per capita changed in past 600 years before a new century. In order to attain a high speed development, individual innovation and leadership innovation strategy is difficult achieved with the industry level available at the time. Learning technology from outsiders and utilizing in own business is the choice that Chinese industry made.

If a car wishes to run faster, it must have a good performance of grip; otherwise it will slide everywhere. The grip, or traction skills, is a base of hold high speed movement. Technology level is the grip for industry development, the industry want to stand stably on its feet in a fast developing economic, only based on a strong technology structure. However, comparing large investment and long return on investment (ROI) time of radical innovation, innovation followership strategy and incremental changes of technology satisfied the company who request high economic growth and good rate of ROI index.

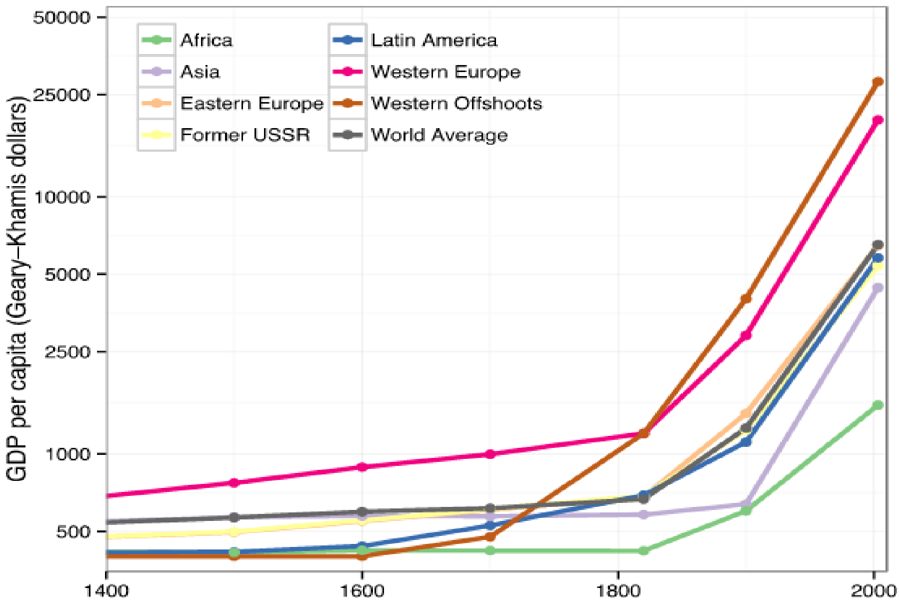

Figure 10. Regional GDP per capita changed very little for most of human history before the Industrial Revolution. (Moore 2012)

Besides historical reason of choosing incremental innovation, a group of data from case company has also been analysis to prove the innovation choice of company. As previous chapter (see Chapter 2.2.) introduced about the innovation process, when a company considering have an innovation in the company the company start from searching opportunity of change. Under the limitation of resources allocation of the firm, innovation should be branched down according to business targets and strategy. It is important not to make too much change in one's time (Francis, D. and J. Bessant 83-

171). SMEs often fail to the research and development survey and other large span of innovative activity. Therefore, SMEs tends to do silence work around process improvement or customer service (Hoffman,K., M. Parejo, J. Bessant, and L. Perren).

Researching the opportunity of innovation can start form analyzing of four broad categories of innovations.

- Innovation in Product:

  Case Company is a manufacturing company of spare and accessory parts for construction machinery and equipment enterprises and other similar companies. The business scope is internal processing on giving materials, processing on giving materials, assembly operation and processing of semi-finished products. There is no specific product made hence the opportunity of innovation in product is limited.

- Innovation in Process:

  The efficiency of production line was low. Some observed shortcoming in the company are recognized, that are high dependence of labor experience, significant produce error variance due to obsolete tools and equipment and disordered manufacturing schedule. To improve operation efficiency will be a good opportunity of innovation.

- Innovation in Position:

  The target customer involves international construction machinery and equipment enterprise and also similar small and middle size companies. Position changes refer to reorganize the place of business. Case company considered extends the business into international scope, but, the weakness of process block the opportunity of innovation in position.

- Innovation in Paradigm:

  The innovation in paradigm for case company could be that changing from processing factory to individual production industry. The only problem is also the weakness of inefficiency production process.

The most possible opportunity of innovation is process development. The case company is similar as other processing industry SMEs, pursuing high speed growth of economic in early stage made technology gaps impeded high quality production process. In the result, before the company innovates from other dimension, process innovation is the initial project should be achieved.

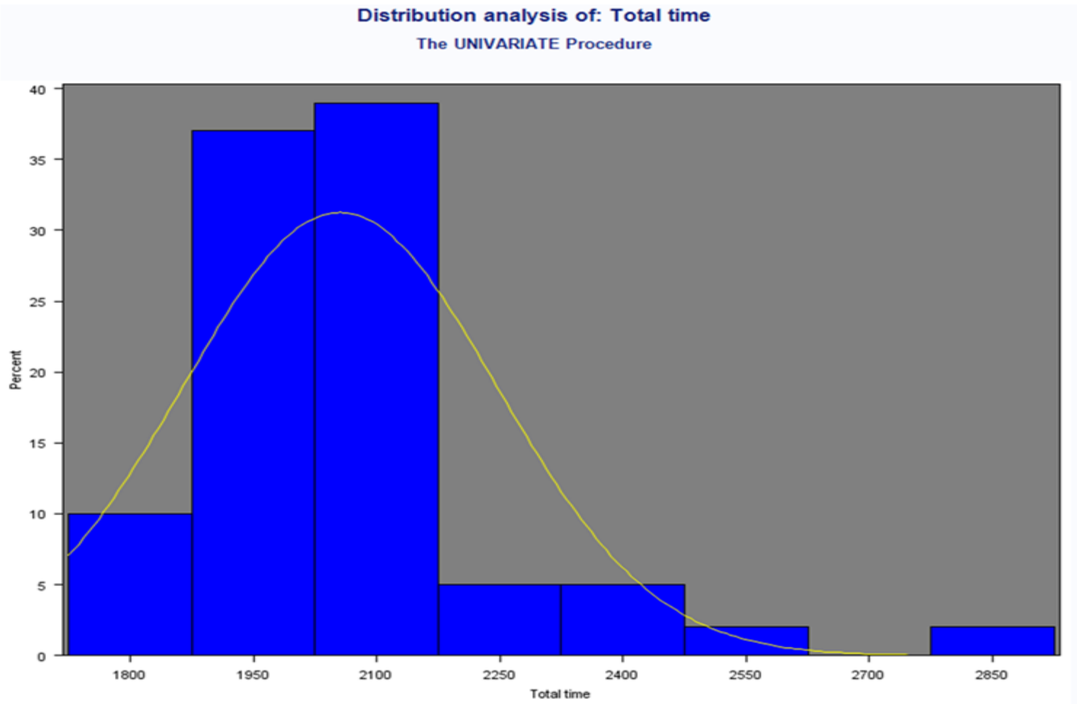

Figure 11. Distribution of total proceeding time for 100 pieces sheet

Before draw up an improvement project, the efficiency of current processing line should be assessed. Figure 11 illustrated total producing time distribution of cutting process of 100 pieces steel sheet. The data present a log- normal distribution that means the distribution of total time is not normal distributed. The distribution of total producing time seems to be positively skewed since the skewess value is around 1.86574 (see Table 5). Because of the skewness, median will be the better value than mean as a measure of location. The median number of total producing time is 2031.5 seconds, which equal to around 34 minutes. Oppositely, the distribution of cutting process with slight setting procedure skewness is -0.00369 (see Table 5) which indicates that machine time distribute is normal distributed, no skewness of distribution. Figure 12 illustrated the distribution of machine time. Operation time is the combination of cutting time with general setting time of machine. The distribution seems to be slight positively skewed since the value is 0.33211 (see Table 5), so the mean value is close to median value. Around 15 minutes used purely of processing the steel sheets.

Table 5. Statistic data analysis between different operations

	Total time	Cutting	Human Setting	Operation
Mean	2055.11	136.56	1142.50	912.61
Median	2031.50	136.00	1110.50	910.00
Std Deviation	191.40	11.69	187.54	35.22
Skewness	1.86574	-0.00369	1.97960	0.33211

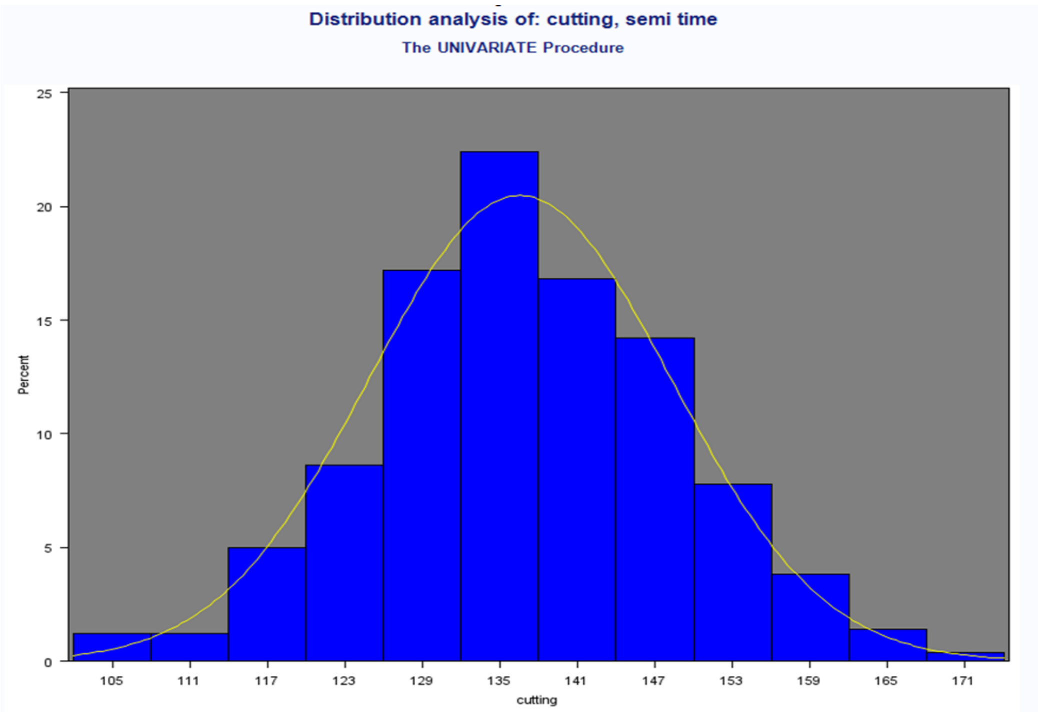

Figure 12. Distribution of machine time

Total producing time equals to operation time plus human setting time. Except normal distributed operation time, human setting time is the only reason of skewed total time. Figure 13 illustrated human setting distributions is log-normal distribution. Table 5 present the skewness value is 1.9796, which is strong positively skewed. The median value is 1110.5, which around 18.5 minutes, are used from human activities. The standard deviation is 187.54, which significantly affect the efficiency of production.

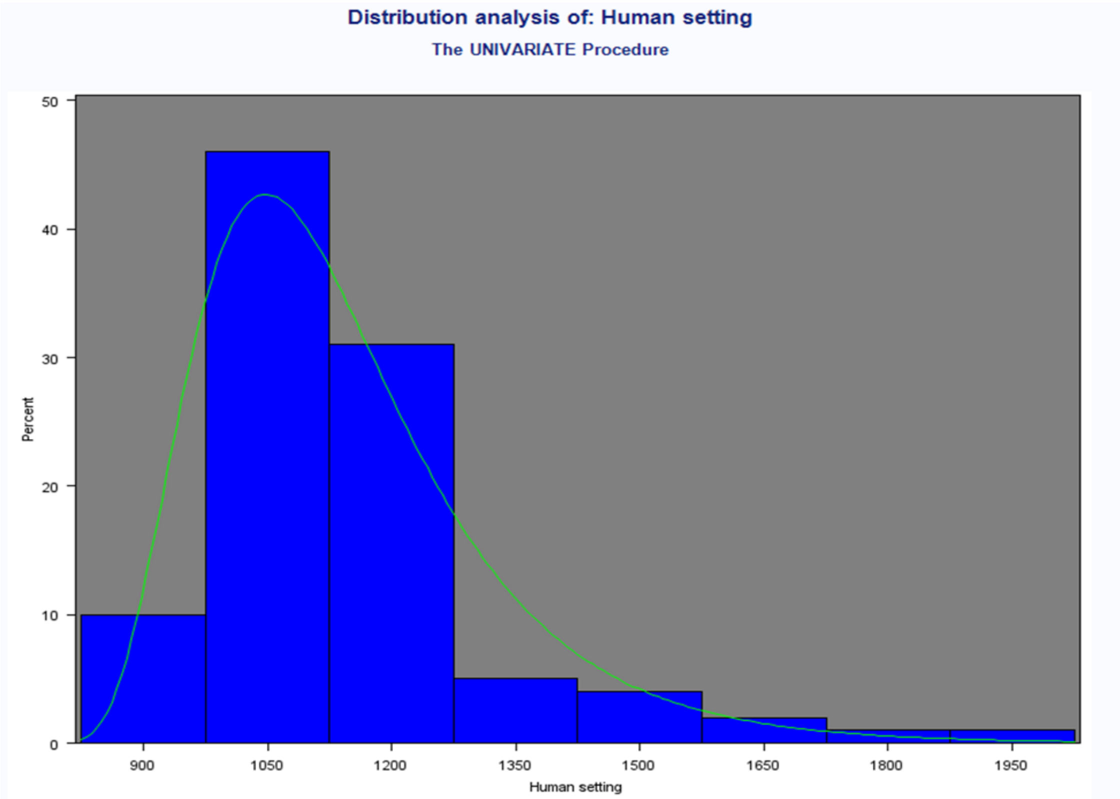

Figure 13. Distribution of human setting time

Correlation test measures the relationship of human setting time with total producing time. Figure 14 illustrated a scatter plot of correlation, besides, the result of Pearson correlation coefficient is 0.98293 (see Figure 15). Both of the data present there is strong positive linear relationship between the variables.

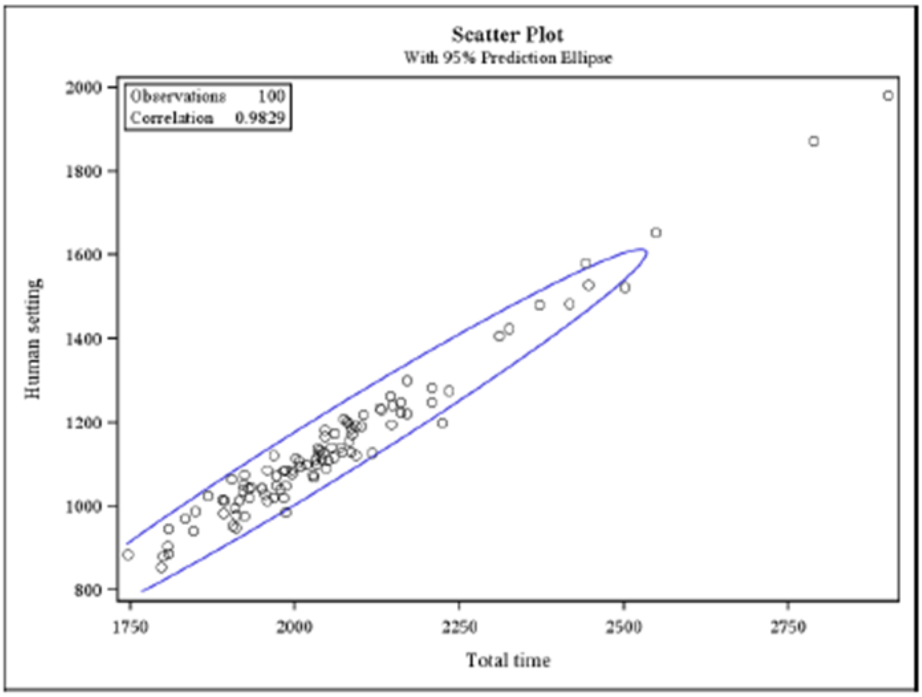

Figure 14. A scatter plot of correlation distribution between human setting time and total proceeding time

Pearson Correlation Coefficients, N = 100 Prob > |r| under H0: Rho=0	
	Total time
Human setting	0.98293 <.0001

Figure 15. Pearson correlation coefficient between human setting time and total proceeding time

Select stage followed with the identification of problems. The case company wastes as much as operation time in human activities, let alone the labor are the most experienced ones. Longer producing time affects schedule organization, which potentially affects competitive advantages.

To resolve this problem, company made two options from incremental innovation and radical innovation perspectives.

- Radical innovation level: According to the most efficiency standard, company used lean approach concept to build a really efficient producing line. The estimated cost of the project will be around 50 thousands euro assumed by financial department. By using the new processing line, the total producing time will reduce half to two-thirds.

- Incremental innovation: Since the data present the human setting is the dissipation cause of inefficiency. Comparing with upgraded equipment or production line, hire another labor that can response to this activity is suggested. The total producing time to estimate reduce one-third.

The company finally selected the second project, because hiring a new labor only cost around 300-400 euro pre month in China. In innovation select stage, company considering realistically issue with company status and taking into account of competitive strategy. The company prefers to choose a clearer return if the unclear changes cannot bring more benefit above manager’s expectation.

Qu Daokui, one of speaker in the interview, mentioned Chinese industry prefers buy technology rather than find alternative items rather than innovate by ourselves. Extremely long cycle time of research and development may limit growth speed. However, technology is the most impartment component of industry which is controlled under several countries that affect and impede Chinese industry development in sophisticated technique.

4.2. Question 2: Radical innovation in large scale or small scale

Generally, SMEs was defined as workforce less than 500 people. (Narula 2004:153-161). In China, SMEs indicated by different industry and number of workforce. A new concept, microenterprise, of industry has been established to extend the group of SMEs (Ministry of Enterprise).

Most literature agreed that small organizations occupied high percentage of innovation activities, since they have a level of innovation advantages, such as speed of decision making, flexibility and high involvement of project. Whilst SMEs and their role as innovators have been seen as sources of growth and high-tech generator firms of this kind are important (Tidd et al. 2011). Chinese technical SMEs started from the beginning of 1980s, until 2005 this group has occupied 90% of total numbers of technical enterprises (Li 2005:45-48). However, most of them are low-tech enterprises, and radical innovation requires a large scope of investment

There are no general comments that prove small companies more innovative than big companies (Zhao, Tong, Wong & Zhu 2005: 209-224). The innovation performance of corporation measured from different indexes, like number of patent application, percentage of new production sales and degree of product newness. Liu (2010: 20-23) researched a relationship between corporate scale with innovation scale for Chinese optoelectronic enterprise. The research presented that the relationship result is flexible with innovation performance indexes setting. Meanwhile, the research also confirmed that the multiple indexes are necessity of the innovation performance measure respectively.

Zhu (2006:45-52) present a research of innovation activities within SMEs based on 800 enterprisers. He presents a significant inverted U-shaped function relationship between the enterprise size and the strength of SMEs innovation spending. Chinese government prefers to invest large and medium-sized industrial enterprises. Some policy tools, such as funding of science and technology and tax relief, are support R&D department of big size enterprisers. Without the financial support from the government, SMEs are more inclined to choose independent innovation way. The activities of innovation between big companies and small companies differ from technology environments (Acs & Audrestsch :1987:109-112). Zhu& Xu (2003:45-53) indicates there is a positively correlation between government's fund and innovation level that the more stable of government support, the better output of innovation.

4.3. Question 3:Barriers of Chinese innovation

Innovation analysis not only from internal of focal company, but also refers to outside of company. Managing business network relationship is also important to managing innovation. In Chapter 2.3., the concept of business relationship has been introduced; business net value and ARA model are been used to explore the external barriers in Chinese innovation process.

- Customer´s perspective:

The core business of case company is processing business. The customer of case company is the terminal manufacturer of product and other similar companies. These customers' features are large quantity, long term relationship and high involvement of business. Figure 16 present the business occupation percentage of different manufacturers in case company. More than 70 present of business come from three manufacturers. Producing structure is flexible according to these customers' order and requirement. Due to the narrow of customer, resources of innovation from customer's perspective are limited. The business strategy from main customer will strongly influence the decision making process of case company.

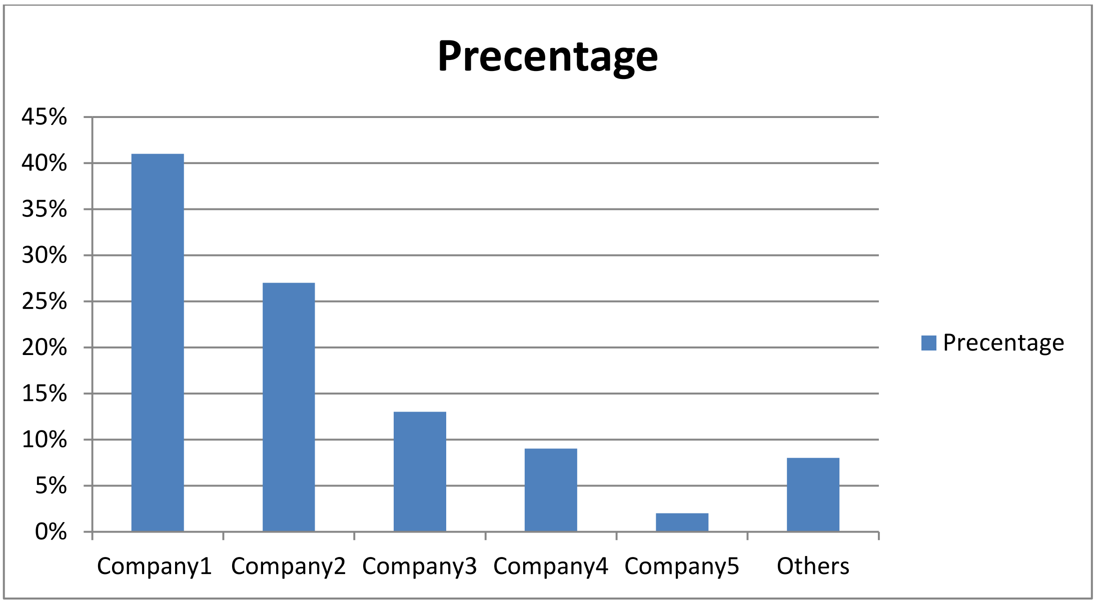

Figure 16. Customers' percentage of focal company

Generally from supply chain management point of view, motivation of innovation start form voice of customer. It is an upstream process, not vice versa. Qu (2014) point out Chinese customer prefers to buy the cheaper one, if there are two similar products. The customer tacit approval the quality of the cheaper one is acceptable since there is no big difference from appearance and simple test with others. Customer desire cheaper manufacturing more than keep standard of product quality which impacted innovation from fundamental level.

- Supplier's perspective:

The case company does both processing with imported materials, processing on giving materials. Since the customers of case company are quite stable, suppliers are stable as customer. The relationship with supplier is also large quantity and long term relationship, but the involvement of business is quite low.

It is different that case company responses to quality of processing and supplier response to quality of raw materials. However, interview indicated that industry standard is cryptically operated in China which affects product quality significantly. There is a case that case company processed an order of given materials, a quality problem has been inspected during completion acceptance stage. Case company cannot get payment since the giving materials have quality problem. The reason behind this problem is the lack of common industry standard.

- Competitors' perspective:

There is lot of similar kinds of factory around case company. Each company has their own main customers. Normally, a good competitor could be a benchmarking for case company. By looking at more profit business and less investment business led competitors around this area trended pricing strategy rather than technology innovation. The relationship with competitor is small quantity low involvement and short term relationship.

- Complementor's perspective:

Firms need other types of firms to increase the value of their own outputs. Handling the dynamic relationship between complementors is important. In manufacturing industry, sometimes competitor could shift their status; it could be also a complementor of case company. Government is another important complementor for SMEs. A positive posture and encouragement policies may stimulate industry increment. Coopertition strategy between different complementor may reduce potential risks in the end. Collaborative networks increase the entire competitive ability. The posture of relationship could be specified in different circumstances.

Appendix 1 (Dutta, Lanvin & Wunsch-Vincent 2015:188) present a rank of Chinese innovation index in 2015. It is present effective innovation policies for development in China. This table indicates advantages and disadvantages of Chines innovation status that China has high level of knowledge, large creative goods exports, but national feature films still rarity. The company should specific their network capability, found out the specific capability which can be combined with other bonds and focus on increate innovation. Re-think the network logic, search a relationship between business networks with strategic relevance to explore a more efficient information and communication technology (ICT) tools to enable and support the change" (Ahokangas et al., 2015:6).

5. CONCLUSION

Innovation is a process to bring an idea into reality. Technology is the foundation of development. It is significant important when industry facing transformation and upgrading stage. Chinese industry SMEs facing the transformation and upgrading stage recently, yet, there are some features need to recognize before the development.

Chinese manufacturers SMEs prefer slow change innovation has historical and economic reason. Comparing with technology developed countries, China has shorter period of technology history. To achieve national economic development from macroscopic, technology copy and paste is the most easiest and faster approach. Meanwhile, innovation followership does not demand a solid technology foundation, close co-operate business network and large support from stakeholders as leadership innovation. Risks of innovation and uncertainty of changes are also clearer of incremental innovation. That is the reason of Chinese manufacturing SMEs prefers a slow change innovation process rather than radical innovation process under present situation.

SMEs have more flexibility to provide high percentage of innovation activities. However, there is no data that prove SMEs are more innovative than big companies. Multiple indexes are necessity of the innovation performance measure respectively. Different indexes of innovation are used according to research variance. Nonetheless, a research presents a positive correlation between stable financial support from government’s fund and output performances of innovation level. Big industry and national manufacturer who get support from government’s fund have a more stable financial base then SMEs.

Industrial collaborative within value net is significant affect innovation performance. To make radical innovation, technology development needs to motivate from customer, supplier and all action bonds in a wild range. Development entirely within one industry's own system blocks the width of the research and generations to innovation. Pursue profits and economic scope treats with indifference of standard of product quality and ethics of business also impact innovation development. Different standard between industries led high risks in innovation. Lack of government support to SMEs also limited possibility change of technology in a large scale.

New concept, made in China 2015, of industry revolution has been launched last year by Chinese government. In this new policy, the SMEs have been encouraged to do innovation in a lager scope. Also, the sophisticated technique and radical innovation have been pointed out significantly. Collaborative networks with each action bonds help to increase the innovation level. Focusing on integration of technology is an important step toward a better understanding of critical dimensions of innovation. Based on government support and standard development, all actor bonds form the industry network will be participated to support entire supply chain development.

6. REFERENCES

ABB. (2015). *Internet of Things, Services and People – IoTSP.* [online]. [Accessed 25 February 2016]. Available from: <http://new.abb.com/about/technology/iotsp>

Acs, Z. J., & Audretsch, D. B. (1987). Innovation in large and small firms. Wissenschaftszentrum Berlin für Sozialforschung, Berlin. *Economics Letters* 23(1), 109-112.

Ahokangas,P., Alila, H., Helaakoski, H., Kyllönen, V., Lehtimäki, T., Peltomaa,I., Seppänen, V., Tanner, H., (2015). *Collaborative-Business-Networks of The Future.* Technical Research Centre of Finland Ltd.

Arrow,K (1962) The economic implications of learning by doing. *Review of Economic Studies* 29 (2), 73-155.

Ayres, R. (1989). *Technological Transformations and Long Waves*. R.U. Ayres International Institute for Applied Systems Analysis. Lazenburg, Austria

Bairoch, Paul. (1982). International Industrialization Levels from 1750 to 1980. *Journal of European Economic History*. 11(2), 12-14. University of Geneva. [online]. 10 Apr. 2015. [Accessed 14 February 2016]. Available from: <http://search.proquest.com/openview/b8f0ecee8c6f027c82a22281c0f46bcf/1?pq-origsite=gscholar.>

Bao, Haisong. (2010). *Why industry revolution initially happens in China?* [online]. [Accessed 27 February 2016]. Available from: <http://www.caogen.com/blog/infor_detail/22249.html>

Bengtsson, M., & Kock, S. (1999). Cooperation and competition in relationships between competitors in business networks. *Journal of Business and Industrial Marketing* 14(3), 178–194.

Bond, E., Gingerich, S., Archer-Antonsen, O., Purcell, L., & Macklem, E. (2003). *The Industrial Revolution – Innovations* [Online]. [Accessed 27 February 2016]. Available from: <http://industrialrevolution.sea.ca/innovations.html>

Brandenburger, A.M., & Nalebuff,B.J. (1997). *Co-optition*. New York. Double Day.

Business Dictionary. (2016). *Definition of innovation* [online] [Accessed 15 March 2016]. Available from: <http://www.businessdictionary.com/definition/innovation.html>.

Capaldo, A., & Petruzzelli, A.M. (2011). In search of alliance-level relational capabilities: Balancing innovation value creation and appropriability in R&D alliances. *Scandinavian Journal of Management* 27(3), 273–286.

CCTV Finance Official Channel (2015).*Ballpoint Pen Challenge High-End Manufacturing.* Talk: CCTV Finance Official Channel, Beijing [Online] 22 Nov 2015 [Accessed 14 December 2015]. Available from: <https://www.youtube.com/watch?v=kZ7li4n-mlY.>.

Chen, Long. (2014). *During the revolution, annual GDP growth double faster than the western powers, economic collapse?* [Online] [Accessed 28 February 2016]. Available from: <http://club.china.com/data/thread/1011/2767/39/62/1_1.html>

Chetty, S. & Blankenburg, H., D. (2000) ‘Internationalisation of small to medium-sized manufacturing firms: a network approach’. *International Business Review* 9(1), 77–93.

Crozier, J. (2002). A unique experiment. Society for Anglo-Chinese Understanding

(SACU). *China in Focus magazine* [online]. 12 [Accessed 27 February 2016]. Available from: <http://www.sacu.org/examinations.html>

Elina Varamäki and Jukka vesalainen. (2003). Modellinmg different types of multilateral co-operation between SMEs. *Enterpreneurship & Regional Development* 15, 27-47.

Engelman, Ryan. (2015). The Second Industrial Revolution, 1870-1914. *US History Scene.* [online]. 10 Apr. 2015. [Accessed 14 February 2016]. Available from: <http://ushistoryscene.com/article/second-industrial-revolution/>.

Fang, C., Park, A. & Zhao, Y. (2008). *China's Great Transformation.* Cambridge: Cambridge university press. [online]. [Accessed: 10 March. 2016]. Available from: <http://ihome.ust.hk/~albertpark/papers/Chinalabor.pdf>.

Francis, D., & Bessant, J. (2005) Targeting innovation and implications for capability development. *Technovation* 25(3), 83-171.

Gadde, L.E.,& Snehota, I. (2000) Making the most of supplier relationships. *Industrial Marketing Management* 29, 305-316.

Germany Trade & Invest. *Smart Factory.* [online]. [Accessed: 10 March. 2016]. Available from: <http://www.gtai.de/GTAI/Navigation/EN/Invest/Industries/Smarter-business/Smart-technologies/smart-factory,t=smart-factory--the-future-of-automated-manufacturing,did=626030.html>.

Harland, C., Brenchley, R., &Walker, H., (2003). Risk in supply networks. *Journal of Purchasing & Supply Management* 9, 51–62.

Hermann, M. Pentek, T. Otto, B. (2015). Design Principles for Industrie 4.0 Scenarios. *Business Engineering Institute* St. Gallen, Lukasstr. 4, CH-9008 St. Gallen.

[online]. Working Paper No. 01 / 2015. [Accessed 3 February 2016]. Available from: <http://www.leorobotics.nl/sites/leorobotics.nl/files/bestanden/2015%20-%20Hermann%20Pentek%20%26%20Otto%20-%20Design%20Principles%20for%20Industrie%204%20Scenarios.pdf>.

Hoffman, K., Parejo, M., Bessant, J., & Perren, L. (1997). Small firms, R&D, technology and innovation in the UK. *Technovation* 18, 39-55.

Hollander, S. (1965). *The sources of Increased Efficiency: A study of DuPont Rayon Plants*, MIT Press, Cambridge, MA

Hudson, P. (1992). *The Industrial Revolution*. London: Edward Arnold.

Håkansson, H., & Snehota, I. (1995). *Developing Relationships in Business Networks*. International Thomson Press. Boston.

Jaikumar, R. (1988) *From Filing and Fitting to Flexible Manufacturing*. Harvard Business School Press. Boston. MA.

Ko, Tin-yau. (2016). What a ball pen tells us about China's manufacturing weakness. *Hong Kong Economic Journal.* [online]. 21 January 2016. [Accessed 26.January 2016]. Available from: <http://www.ejinsight.com/20160121-what-ball-pen-tells-us-about-china-s-manufacturing-weakness>.

Lesli. R. Scott. (2013). *Statistical Analyses Using SAS Enterprise Guide* 407-412 SAS Global Forum 2013.

Li, Chengrui. (1984). National economic status analysis in past ten years – statistic data reliability analysis. *Economic Analysis.*[online] 1, 23-31. [Accessed 28 February 2016]. Available from: <http://www.erj.cn/UploadFiles/%E5%8D%81%E5%B9%B4%E5%86%85%E4%B9%B1%E6%9C%9F%E9%97%B4%E6%88%91%E5%9B%BD%E7%BB%8

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Li, Haibo. (2005). Technology-based SMEs in the western countries. *Strait Technology and Industry* 4, 45-48.

Li, Peigang (2016). *Why China Cannot Make The Ball Bead of A Ball Pen? Ball Bead Indicate Technology Shortcomings.* [Online] 28 January 2016 [Accessed 10 February 2016]. Available from: <http://www.china.com.cn/cppcc/2016-01/28/content_37686700.html>.

Liu, Jingyin. (2010). An empirical research on the relationship between enterprise size and innovative performance of enterprise——based on photoelectron industry in china. *Soft Technology* 24(4), 20-23.

Ministry of Enterprise. (2011). *The Standard Notice Issued By The Small And Medium-Sized Enterprises.* Issue 2011/300.

Moore, Ben. (2015). *Regional GDP per Capita Changed Very Little for Most of Human History before the Industrial Revolution.* [online]. 10 Apr. 2015. [Accessed 14 February 2016]. Available from: <http://creativecommons.org/licenses/by-sa/3.0>.

Moore, Geoffrey A. (2015). *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers.* [online] [Accessed 04 March 2016]. Available from: <http://www.theagileelephant.com/crossing-chasms-and-digital-waves/>.

Mulholland, A. (2014). *Internet of Things – No, it's the Internet of Services. Constellation research.* [online]. [Accessed 25 February 2016]. Available from: <https://www.constellationr.com/content/internet-things-no-it-s-internet-services>

Myllärniemi, J., Vuori, V., Helander, N., Ilvonen, I., Okkonen, J., & Virtanen, P. (2013). The role of an intermediator organisation in collaboration: how can an intermediator enhance value co-creation? *International Journal Applied Systemic Studies* 5(1/2), 15-21.

Narula, R. (2004). R&D collaboration by SMEs: New opportunities and limitations in the Face of Globalization. *Technovation* 24,153-161.

Quinlan, Babin, Carr, Griffin & Zikmund. (2015). *Business Research Methods*. 1st Edition. Cengage Learning EMEA. United Kindom.

Ritter, T., & Gemünden, H. G. (2003). Network competence: Its impact on innovation success and its antecedents. *Journal of Business Research* 56(9), 745–755.

Ritter, T., Wilkinson, I.F., & Johnston, W.J., (2004). Managing in complex business networks. *Industrial Marketing Management* 33, 175-183.

Schwab, K. (2016). *The Fourth Industrial Revolution*. World economic forum 2016CH-1223 Cologny. Geneva.

Soumitra Dutta, Bruno Lanvin, and Sacha Wunsch-Vincent. (2015). The Global Innovation Index 2015: Effective Innovation Policies for Development, Fontainebleau, Ithaca, and Geneva. *World Intellectual Property Organization* [online] [Accessed 04 January 2016]. Available from: <https://www.globalinnovationindex.org/content/page/gii-full-report-2015/>

Takano, Atsushi (2014). Guess, what is industry? *Business Weekly.* [online]. 10 Apr. 2015. [Accessed 2 February 2016]. Available from: <http://www.businessweekly.com.tw/KBlogArticle.aspx?id=6328>.

The State Council. (2015). Made in China 2025. Circular 28/ 2015. [Online]. [Accessed 27 February 2016]. Available from: <http://finance.sina.com.cn/china/20150519/112322214243.shtml>

Tidd,. J.,& Bessant, J. (2011). *Managing Innovation: Integrating Technological, Market And Organizational Change.* 4th edition. John Wiley & Sons ltd. England.

Tidström, A., (2014). Managing tensions in coopetition. *Industrial Marketing Management* 43, 261–271.

Tidström, A. & Hagberg-Andersson, Å, (2012). Critical events in time and space when cooperation turns into competition in business relationships. *Industrial Marketing Management* 41, 333–343.

Vesalainen, J., & Hakala, H. (2014). Strategic capability architecture: The role of network capability. *Industrial Marketing Management* 43, 938–950.

Varamäki, E. & Vesalainen, J. (2003). Modeling different types of multilateral co-operation between SMEs. *Entrepreneurship & regional development* 15, 27-47.

Walter, A., Ritter, T. and, H.G. (2001) 'Value creation in buyer-seller relationships', *Industrial Marketing Management* 30(4), 365–377.

World Development Indicators Database, (2016). *GDP ranking*. World Bank. [Online] 26 January 2016 [Accessed 17 February 2016]. Available from: <http://databank.worldbank.org/data/download/GDP.pdf>.

Williams, D. (2004). *The Birmingham Gun Trade*, Tempus,Stroud.

Worstall, Tim (2016). *China Can't Make a Ballpoint Pen, and Why We Shouldn't Worry About TRIPS.* [Online] 26 January 2016 [Accessed 10 February 2016]. Available from: <http://www.forbes.com/sites/timworstall/2016/01/26/china-cant-make-a-ballpoint-pen-and-why-we-shouldnt-worry-about-trips/#5790aaa3ed0f>.

Xu, Yunbing (2016). *China cannot produce ball pen, a question to ball pen manufacturer and also to Chinese manufacturing.* [Online] 28 January 2016 [Accessed 10 February 2016]. Available from: <http://www.china.com.cn/cppcc/2016-01/28/content_37681163.html>.

Zhao, H., Tong, X., Wong, P. K., & Zhu J. (2005). Types of technology sourcing and innovative capability: An exploratory study of Singapore manufacturing firms. *High Technology Management research* 16, 209-224.

Zhu, Fangpin., & Xu, Weimin. (2003). The government's incentive policy of science and technology for large and medium-sized industrial enterprise the influence of R&D input and patent output -- empirical research in Shanghai. *Shanghai university of Financial & Technology Economic Research* 6, 45-53.

Zhu, Hengpeng. (2006). Enterprise scale, market forces and private enterprises innovation behavior *Technovation* 12, 45-52.

APPENDIX 1. Global Innovation Index: Chinese Economy Profiles

Key indicators

Population (millions)	1,393.8
GDP (US$ billions)	10,380.4
GDP per capita, PPP$	10,694.7
Income group	Upper-middle income
Region	South East Asia and Oceania

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 141)	**47.5**	**29**	
Innovation Output Sub-Index	46.6	21	
Innovation Input Sub-Index	48.4	41	
Innovation Efficiency Ratio	1.0	6	●
Global Innovation Index 2014 (out of 143)	46.6	29	

		Score / value	Rank	
1	**Institutions**	**54.0**	**91**	
1.1	Political environment	45.6	79	
1.1.1	Political stability*	50.7	99	
1.1.2	Government effectiveness*	40.6	70	
1.2	Regulatory environment	49.6	115	
1.2.1	Regulatory quality*	39.6	92	
1.2.2	Rule of law*	35.5	88	
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	118	○
1.3	Business environment	66.7	78	
1.3.1	Ease of starting a business*	77.4	105	
1.3.2	Ease of resolving insolvency*	55.3	51	
1.3.3	Ease of paying taxes*	67.4	94	
2	**Human capital & research**	**43.1**	**31**	
2.1	Education	70.8	2	●
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	13.1	78	
2.1.4	PISA scales in reading, maths, & science	587.5	1	●
2.1.5	Pupil-teacher ratio, secondary	14.5	59	
2.2	Tertiary education	11.7	121	○
2.2.1	Tertiary enrolment, % gross	26.7	82	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	0.3	103	○
2.3	Research & development (R&D)	46.9	21	
2.3.1	Researchers, FTE/mn pop.	1,071.1	47	
2.3.2	Gross expenditure on R&D, % GDP	2.1	17	
2.3.3	QS university ranking, average score top 3*	78.5	11	
3	**Infrastructure**	**50.5**	**32**	
3.1	Information & communication technologies (ICTs)	51.6	54	
3.1.1	ICT access*	51.0	77	
3.1.2	ICT use*	29.9	71	
3.1.3	Government's online service*	60.6	47	
3.1.4	E-participation*	64.7	33	
3.2	General infrastructure	65.1	3	●
3.2.1	Electricity output, kWh/cap	3,690.5	52	
3.2.2	Logistics performance*	69.9	27	
3.2.3	Gross capital formation, % GDP	47.7	4	●
3.3	Ecological sustainability	35.0	82	
3.3.1	GDP/unit of energy use, 2005 PPP$/kg oil eq	4.5	103	○
3.3.2	Environmental performance*	43.0	102	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	6.5	17	
4	**Market sophistication**	**49.2**	**59**	
4.1	Credit	31.9	63	
4.1.1	Ease of getting credit*	50.0	65	
4.1.2	Domestic credit to private sector, % GDP	140.0	16	
4.1.3	Microfinance gross loans, % GDP	0.0	86	○
4.2	Investment	36.6	62	
4.2.1	Ease of protecting investors*	45.0	114	○
4.2.2	Market capitalization, % GDP	44.9	44	
4.2.3	Total value of stocks traded, % GDP	70.8	8	
4.2.4	Venture capital deals/tr PPP$ GDP	0.1	34	
4.3	Trade & competition	79.2	59	
4.3.1	Applied tariff rate, weighted mean, % ◕	4.1	66	
4.3.2	Intensity of local competition†	72.6	42	
5	**Business sophistication**	**44.9**	**31**	
5.1	Knowledge workers	61.2	20	
5.1.1	Knowledge-intensive employment, % ◕	7.4	104	○
5.1.2	Firms offering formal training, % firms ◕	79.2	1	●
5.1.3	GERD performed by business, % of GDP	1.6	13	
5.1.4	GERD financed by business, %	74.6	3	●
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	31.1	71	
5.2.1	University/industry research collaboration†	56.7	31	
5.2.2	State of cluster development†	59.3	23	
5.2.3	GERD financed by abroad, %	0.9	89	○
5.2.4	JV–strategic alliance deals/tr PPP$ GDP	0.0	57	
5.2.5	Patent families 3+ offices/bn PPP$ GDP	0.3	29	
5.3	Knowledge absorption	42.6	32	
5.3.1	Royalty & license fees payments, % total trade	0.9	35	
5.3.2	High-tech imports less re-imports, % total trade	18.8	8	●
5.3.3	Comm., computer & info. services imp., % total trade	0.3	112	○
5.3.4	FDI net inflows, % GDP	3.8	40	
6	**Knowledge & technology outputs**	**58.0**	**3**	●
6.1	Knowledge creation	64.1	6	●
6.1.1	Domestic resident patent app./bn PPP$ GDP	43.6	1	●
6.1.2	PCT resident patent app./bn PPP$ GDP	1.4	27	
6.1.3	Domestic res utility model app./bn PPP$ GDP	54.7	1	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	14.0	53	
6.1.5	Citable documents H index	436.0	16	
6.2	Knowledge impact	67.2	1	●
6.2.1	Growth rate of PPP$ GDP/worker, %	7.1	1	●
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.4	23	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	20.8	19	
6.2.5	High- & medium-high-tech manufactures, %	43.1	15	
6.3	Knowledge diffusion	42.8	28	
6.3.1	Royalty & license fees receipts, % total trade	0.0	76	
6.3.2	High-tech exports less re-exports, % total trade	28.4	1	●
6.3.3	Comm., computer & info. services exp., % total trade	0.7	86	
6.3.4	FDI net outflows, % GDP	1.8	36	
7	**Creative outputs**	**35.1**	**54**	
7.1	Intangible assets	52.4	39	
7.1.1	Domestic res trademark app./bn PPP$ GDP	107.2	11	
7.1.2	Madrid trademark app. holders/bn PPP$ GDP	0.1	54	
7.1.3	ICTs & business model creation†	60.6	47	
7.1.4	ICTs & organizational model creation†	61.4	32	
7.2	Creative goods & services	33.0	35	
7.2.1	Cultural & creative services exports, % total trade	0.2	49	
7.2.2	National feature films/mn pop. 15–69	0.6	89	○
7.2.3	Global ent. & media output/th pop. 15–69	3.0	47	
7.2.4	Printing & publishing output manufactures, %	0.5	91	○
7.2.5	Creative goods exports, % total trade	14.0	1	●
7.3	Online creativity	2.6	104	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.3	84	
7.3.2	Country-code TLDs/th pop. 15–69	4.5	54	
7.3.3	Wikipedia edits/pop. 15–69	149.8	110	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◕ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data.