The Factors Which Effect on the Diffusion of Information and Communication Technology in China

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Abstract

At this age, information and communication technology (ICT) are spread all over every corner of the world in a surprising speed, which deeply influences every aspect of our daily lives. Two factors can lead to diffusion of ICT innovation based on a case study, which was about internet cafe in China. The first factor is influence of new technology; the second factor is that stress or policies which come from society or governments.

Key words: Information and communication technology; Diffusion; Innovation; Internet cafe

INTRODUCTION

Since the first Internet cafe named Cyberia was opened by Eva Pope who came from Poland in 1994, incomputable Internet cafes have been opened worldwide. Internet comes from APPNET, which was designed for US military affairs. With development to today, it effects on the whole society. At the same time, as a ramification of Internet, Internet cafe has become a kind of industry in many countries. Internet cafe did not appear with Internet. It developed bit by bit with the innovation of Internet. Internet cafe exactly was opened after technology of local area network had been grown up. How and why does it diffuse to a kind of industry of today? What is the process of its diffusion? What factors would affect on the diffusion of Internet cafe? This report will focus on these questions and give some points.

The first part introduces the background of Internet cafe. This report mainly investigates Internet cafe of China, so next it is a short explaining about history of Internet cafe in the world and in China. This part indicates some clew of how and why it diffuses to a kind of industry of today. The second part gives documentation of assumptions. It tells which market this study focuses on, where data comes from, which tool is used to create s-curve, what model of diffusion is used to forecast, and why choose average coefficient of innovation and coefficient of imitation. The third part tells market segmentation. There are different ways to divide market, here four ways are discussed, and they are segmented by gender, period of age, situation of marriage, and experience of education. At the end of this part, a short conclusion of market segmentation is given, pointing out who are the majority of customers of Internet cafe. The fourth part is about adoption/diffusion discussion of Internet cafe. This part answers questions of what the process of its diffusion is and what factors would affect on the diffusion of Internet cafe. It gives two factors that would effect on diffusion of Internet cafe in China. One is technical factor and another is policy's factor. Then this part also has a case study about Xingmei Internet cafe chain in the Sichuan province of China and explains how this big Internet cafe chain developed, innovated and finally succeeded and created an ideal environment for gamers and improved Xingmei's market influence. The fifth part is interpreting the results. It explains why degree of increasing is different during different periods. This explaining is according to two factors of influencing market discussed in the fourth part. The sixth part is what my findings from study are. Two factors can

lead to same results to diffusion of ICT innovation, or completely contrary results to diffusion of ICT innovation. The last part of main body is what is the future of the ICT Innovation and why. That assumption comes from prevenient analyses.

1. BACKGROUND OF INTERNET CAFE

An Internet cafe is a place that provides Internet access to people, and people have to pay for using computer in this place. The fee for using a computer is usually charged as a time-based rate. Internet cafe is called so because these businesses usually provide snacks and drinks.

1.1 History of Internet

Before talking about Internet cafe, Internet should be mentioned. Licklider of MIT indicated his *Galactic Network* concept, which is the first recorded description of the social interactions in August 1962. In this concept, the interactions can be through networking.

Internet actually comes from original Advanced Research Projects Agency Network (ARPANET). ARPANET, which based on Honeywell minicomputer, was built in 1969. This physical network that was wired by 50 Kbps circuits linked four nodes which are Stanford Research Institute, University of California at Los Angeles, University of Utah, and University of California at Santa Barbara.

The next important thing about Internet is protocol called TCP/IP. This protocol, which developed by Vinton Cerf from Stanford and Bob Kahn from DARPA, allows diverse computer networks to interconnect and communicate with each other (Cerf & Kahn, 1974, pp.627-641).

Ethernet is developed by Dr. Metcalfe, and it could allow coaxial cable to transfer data excessively fast. This was a foundation of the development of LANs. In the other words, it was the basic technology to Internet cafe.

A nonprofit corporation called Advanced Network & Services (ANS) was organized by Merit, IBM, and MCI. This was to conduct research into high speed networking.

CERN released World Wide Web in 1992, and NSF created Inter NIC to provide specific Internet services. The services include directory and database services (by AT&T), registration services (by Network Solutions Inc.), and information services (by General Atomics/CERF net) in 1993 (Kristula, 1997). Many hosts joined in the Internet in the next year.

Until now, Internet has been an indispensable part of social life, economic life, and political life. It revolutionized computer and communication world, which had never been done before.

1.2 The Development of Internet in China

The development of Internet can be divided at a glance into two phases in China. The first one is from 1987 to 1993, and in this phase, China just cut off the connection of e-mail to the world. The next one is from 1994 to now, and in this phase, China can really connect to the world and get all services through TCP/IP protocol.

A department of the government of China and Karlsruhe University of Germany started up the project of Chinese Academic Network (CANET) in 1986. The first e-mail node of Internet was established in September, 1987 by X.25, and the fist e-mail from Beijing was sent on September 20, 1987. The top domain name CN was registered in October 1990. After CANET, several universities and graduate schools could also send e-mails to the world. However, only e-mail system was not enough for the development of technology and economy, more and more users wanted to implement connection to Internet with full functions.

In the second phase, China implemented connection of TCP/IP protocol to Internet and got all services: directory and database services, registration services, and information services. This process began with the National Computing and Networking Facility of China (NCFC), which was for scientific research and management of scientific research, in 1990 and succeeded in April, 1994. The government started the China Education and Research Network (CERNET) from 1994 to 2000。 CERNET connected more than one hundred universities and thousands of high schools and elementary schools. All of them could share information and resources conveniently and quickly. The most popular network in China is CHINANET, which began in 1994. Its purpose was providing all kinds of services for public users.

Although the history of Internet in China is not too long, it developed so rapidly. And all of these provide the base for Internet cafe because the development of Internet cafe depends on the quantity of Internet users.

1.3 The History of Internet Cafe

Since the first Internet cafe in the world is Cyberia, which was opened on the Whitfield Street, London on September 1, 1994 by Eva Pope who came from Poland, there are now countless such cafes around the world, with even the most remote areas featuring a web surfing service.

Commissioned to develop an Internet event for an arts weekend at the Institute of Contemporary Arts (ICA) in London and inspired by the SF net terminal based cafes, Pope wrote a proposal outlining the concept of a cafe with Internet access In June, 1994, the Binary Cafe, Canada's first Internet cafe, opened in Toronto, Ontario.

The first recorded Internet cafe called Shihuakai in China was opened close to the Capital Gymnasium in Beijing by Shihuakai Company on November 11, 1996. Since that, a large amount of Internet cafes increased sharply like everywhere in the world.

The purpose of Internet cafe is that many people use them to keep in touch with family and friends by accessing email and instant messaging in the early days.

A variation of Internet cafe called PC bang which was actually local area network (LAN) gaming center became startlingly popular in South Korea and China when more and more personal computer games were released during that period. Although computer and broadband penetration per capita were very high, young people still went to this kind of Internet cafe to play multiplayer games.

The most Internet cafe appeared in this period because the LAN technology, on which Internet cafes base, was becoming ripeness completely.

2. TECHNOLOGICAL BASE OF INTERNET CAFE

The technological base of Internet cafe is LAN. Before talking about Internet cafe, LAN technologies should be known. LANs have flourished over the past years to become an integral part of the office environment. Many LAN technologies have been introduced, but only a few have proven themselves and become readily accepted.

2.1 Definition of LAN

LAN is a group of computers and associated devices that share a common communication line or wireless link within a small scale region. These devices include microcomputers, external devices, network interface card, and telecommunication line and also has relevant network control software (Su, Yang, & Zhang, 2002, pp.3-22).

LAN is an important part of computer network and also is a very active field of computer network technology application today. Connected computers share the resources and transfer information in many places, such as companies, government, and universities.

The development of LAN began in 1970s, and LAN developed at top speed in 1990s because network speed and bandwidth, which are two most important elements for LAN, improved a lot in that period. At the same time, other LAN technologies, such as services, management, security, and encryption, became mature day by day. For example, data transfer rate of Ethernet increased rapidly from 10Mbps to 100Mbps, even to 1000Mbps.

Some of more popular LAN technologies are enumerated below:
- ARCnet;
- Ethernet;
- Token-ring;
- AppleTalk;
- FDDI/TP-PMD;
- High-speed Ethernets;
- ATM.

2.2 The LAN Technology Characteristics

Comparing other Internet technologies, LAN has its own characteristics as following:
- A LAN resides in a small geographical area, such as a campus.
- Data transfer rate is very fast. The rate was only 1Mbps at the beginning, and then reached 10Mbps, 100Mbps, and 1000Mbps in a short period; now it can even be 10000 Mbps.
- A LAN has lower network delays and bit error rate, which is ordinarily from 10-8 to 10-10.

2.3 The LAN Topology

In computer network, equipment, such as computers and terminals, was considered as point. Telecommunication Lines which connect devices were considered as lines. Those points and lines constitute a topology, which is called network topology (Wu & Liu, 2006, pp.14-41). Network topology can reflect the type of construction, and it is important to performance and reliability of network. Therefore, the design of network topology plays a very important part in the whole network design, and it should be thought about first.
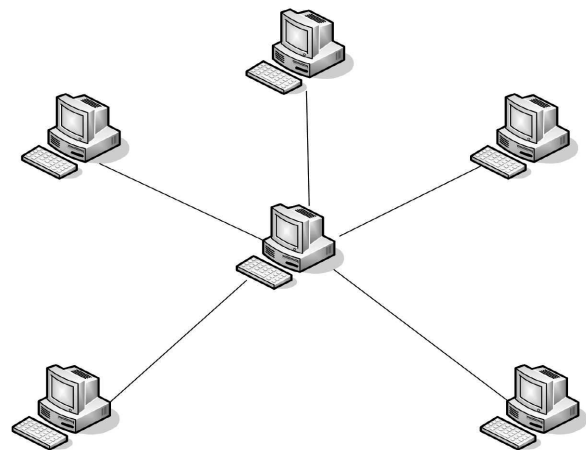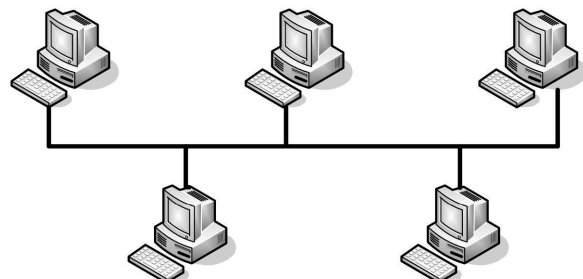

Figure 1
Star Topology
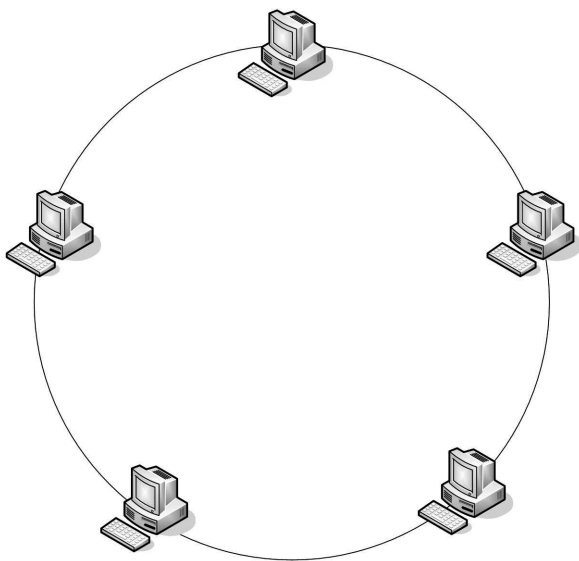

Figure 2
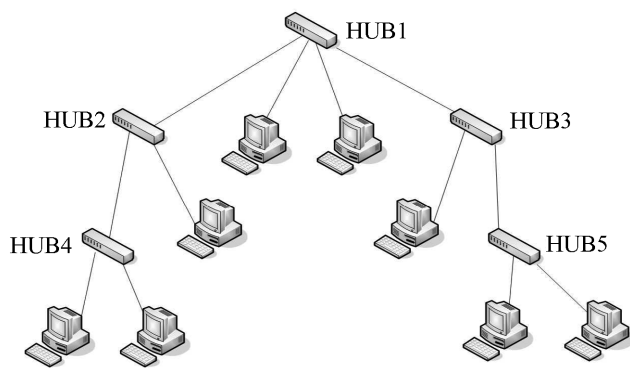**Bus Topology**

Figure3
Ring Topology

Figure 4
Tree Topology

There are mainly four types of LAN topology when building LAN:

(a) The first one is star topology (Figure 1). A star network is one of the most ordinary topologies. There is a central node that could be a hub, a computer, or a switchboard on this topology. And all of other computers and devices connect to the central node.

(b) The second one is bus topology in which all computers and devices are connected to a single cable or a communications line (Figure 2).

(c) The third one is ring topology in which each computer or device connects to other two computers or devices, and finally forming a closed circle that likes a ring (Figure 3).

(d) The fourth one is tree topology (Figure 4). A tree topology comes from bus topology. It looks like an inverted tree by combining bus topology with star topology.

Only several typical LAN topologies are introduced above. In reality, Internet cafes choose one single topology or mixed topology to build network based on actual situation.

There are other LAN technologies, such as IEEE802 standards which include a series of international standards about LAN, will be used when building network of Internet cafe. All of them are necessary for Internet cafe, so LAN technology is the main technological base of Internet cafes.

3. DOCUMENTATION OF ASSUMPTIONS

This study focuses on China. Most data comes from web site of Ministry of Culture of the People's Republic of China. Some comes from annual reports.

Theoretically every one can go to Internet cafe, but there is a problem that most people in countryside cannot go to Internet cafe because there is no this kind of equipment. Actually people in countryside are still very poor. The percentage of population in cities was about 40.53% in 2003, and population was about 0.52376 billion. Furthermore, people under 10 years old and beyond 70 years old were about 16.63%, so the real amount of people who could go to Internet cafe was about 0.43666 billion. This is what I assume about users of Internet cafe. All these data are from the National Bureau Statistics of China.

The population of China will increase continually in the next a few years according to analysis from National Bureau Statistics of China, so the percentage of people who can go to Internet cafe will increase with this.

The reasons choosing this data is that diffusion of Internet cafe is affected by not only technical factors but also other external factors such as policies of the government, for example, one policy about Internet cafe is that every Internet cafe in China has to have more than 20 computers at least. All about these factors which would influence diffusion of Internet cafe will be discussed in the chapter 5.

4. MARKET SEGMENTATION

There are several ways to divide the market of Internet cafe. The first way is that the market is carved up to male users and female users of Internet cafe from gender in a nutshell. The second way is dividing the market of Internet cafe based on age. The third way is according to whether people have married or not. The last way is depending on education level of customers who go to Internet cafe.

It is easy to start if market segmentation is just made by male and female users. According to *Investigate Report about Internet Cafe Industry of China* (Ministry of Culture of the People's Republic of China, 2012), about 90% of customers of Internet cafe was male in China in 2004, and only no more than 10 per cent of customers of

Internet cafe was female. One reason that leads to this is the custom of China from ancient times. The custom is that a good girl should not go out very often, especially to a public rumpus room, of course including Internet cafe, because most people just want to relax at there. Another reason is from functions of Internet cafe itself. There are two main functions of Internet cafe in China: One is certainly providing services of surfing on the Internet; another is playing Internet games in Internet cafe. At least 31% of people in Internet cafe play Internet games, and the peak of this percentage could reach 70 in 2004 in China from the report of Ministry of Culture of the People's Republic of China.

The second way which is based on age is more complex than the first way. Investigators divided customers into 5 parts: under 18 years old, from 18 to 30 years old, from 31 to 45 years old, and beyond 45 years old. People who are under 18 years old are still nonage, and they do not have the right to work and are under an obligation to go to school, so people who are during this period of age do not have enough time and money to Internet cafe frequently. People who from 18 to 30 years old usually have own work and leisure time, and it is a good way to relax by whatever playing Internet game, surfing on the Internet, or making friends through Internet at Internet cafe. In fact, the percentage of this group was more than 70 from the report of Ministry of Culture of the People's Republic of China. People who are from 31 to 40 years old have to spend much more time on their business, and people who are beyond 40 years old should take responsibilities to family and children. So they both seldom go to Internet cafe.

The third way is based on the situation of marriage. Research from Ministry of Culture of the People's Republic of China showed that about 65% of customers of Internet cafe were unmarried. This is because they are single and just need to think about themselves, so they have more freedom than married people.

The fourth way is found on experience of education. About 54% of customers of Internet cafe have bachelor degrees.

In short, the majority of customers of Internet cafe are unmarried male people who are from 18 to 30 years old and at least graduate from university.

5. ADOPTION/DIFFUSSION DISCUSSION

The adoption or diffusion of Internet cafe mainly depends on two factors that are technical factor and policy's factor.

On one hand, Ethernet which was developed by Dr. Metcalfe is the base of Internet cafe to a certain extent. It can transfer data and information extremely fast by coaxial cable. Local area network which is adopted widely by Internet cafe comes from this technology. A new technology that can replace local area network is wireless

technology, but its cost is much more expensive to afford normal Internet cafe, so most Internet cafes still base on local area network. It could be said that technology of Internet cafe is developed maturely and acceptably.

On the other hand, there are some restrictive policies about Internet cafe from government to restrict the diffusion of Internet cafe in China. There are some mail policies issued by Ministry of Culture of the People's Republic of China about Internet cafe:

- There are at least 20 computers in each Internet cafe.
- The owner of Internet cafe must provide private space of no less than 2 m^2 to each customer.
- Business hours of Internet cafe cannot exceed midnight except public holiday. Opening for whole night is extremely forbidden.
- People who are under 18 years old cannot go to Internet cafe except public holiday (now it has changed to people who are under 18 years old cannot stayed at Internet cafe for more than 3 hours per day except public holiday).
- No violence games are permitted at Internet cafe.
- Pornography web sites are not permitted at Internet cafe.

It must be acknowledged that some policies are very required for excellent environment and development of Internet cafe.

Below gives a case study of Xingmei Internet cafe to show how an Internet cafe developed successfully.

6. CASE STUDY OF XINGMEI INTERNET CAFE

Rapid development of information technology leads to possibility of the virtual organization. Appearance of the virtual organization needs more powerful information management. When information management cannot meet the expectations of virtual organization, this means challenges are coming. When information management beats these challenges, it can evolve the virtual organization.

Xingmei is a big Internet cafe chain which has no less than 300 outlets in the Sichuan province of China. Xingmei realized that Internet cafe industry as a whole, of course including itself, lacked cohesion with increasingly fierce competition and diffusion of technology of Internet cafe in China. If it wanted to guarantee its long-term and steady development, it had to find a new way to appeal customers to its Internet cafes. Xingmei noticed that Internet games had a large customer base by a thorough investigation. It was very necessary to build a comfortable environment and expand market influence as widely as possible. The active reaction from this would attract even more customers, thus bringing the standard of entertainment of Xingmei Internet cafe to a new high

level. Internet games require hardware platforms that are as robust as possible. To achieve this purpose, Xingmei Internet cafe decided to build a new hardware system targeted for Internet games by using a Gigabit network based on Intel PRO/1000 MT Desktop Adapters and desktop computers based on Intel Pentium 4 processors supporting Hyper-Threading (HT) Technology1. By doing so, Xingmei expected breakthroughs in three areas:

- building an excellent image in the Internet cafe industry;
- creating new and attractive areas to ensure its long-term development;
- changing the circumstances, in which games play an important role in the Internet cafe industry.

Not plain sailing in the process, the difficulty it faced was to convince all of Xingmei's licensed outlets to create a better environment as a means to attract more players. However, finally, Xingmei solved this problem by adopting a flexible and diversified method that used facts as justification for investment in new technology. Xingmei Internet cafes succeeded at last in creating an ideal environment for gamers and improving Xingmei's market influence. Those are the two main goals that Xingmei Internet cafe wanted to achieve.

7. GRAPHICAL RESULTS AND INTERPRETING THE RESULTS

Table 1 shows the number of Internet cafe in China from 1996 to 2012. This number comes from the National Bureau of Statistics of China. We have supplied the source webpage in the reference list in order for people to check these numbers.

Table 1
Number of Internet Café in China (Thousand)

Year	1996	1997	1998	1999	2000	2001
Amount	0.018	4.5	20	40	70	90
Year	2002	2003	2004	2005	2006	2007
Amount	130	113	103	112	124	126
Year	2008	2009	2010	2011	2012	
Amount	130	138	144	146	136	

Because Internet cafe started at the end of 1996 in China, it was a completely new business to Chinese market and there was not much time to develop it. That is why there were only no more than 20 Internet cafes in that year. From 1997 to 1998, more and more people knew this new business, so more and more Internet cafes appeared, and at the end of 1998, the number of Internet cafes reached 20,000. As the technology of LAN was consummated and the owners of early Internet cafes won

considerable profits, more new generation of owners joined the Internet cafe industry, which dramatically increased the quantity of Internet cafes from 1999 to 2002. However, government noticed the negative responses brought by Internet cafes in 2002 and decided to make policies to restrict Internet cafes (Su, Yang, & Zhang, 2002, pp.3-22), and with increasingly fierce competition profits from Internet cafe began to reduce, so in the next two years, the number of Internet cafes started decreasing. After a period of adaptation, the owners of Internet cafes understood policies more clearly, more Internet cafes were opened. That is why the number of Internet cafe increased from 2005 to 2006, and exact numbers were 112 thousand and 124 thousand in 2005 and 2006, respectively. Another policy was made to guide the development of Internet cafe in 2007. It was that the government encouraged new investors to build chain of Internet cafe and limited opening single Internet cafe at the same time. The policy influenced the quantity of Internet cafes. That's why the number of Internet cafe rose in some years and declined in the other years from 2008 to 2012.
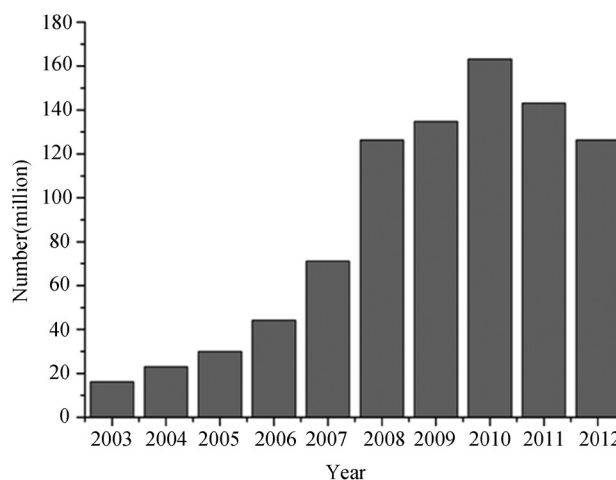

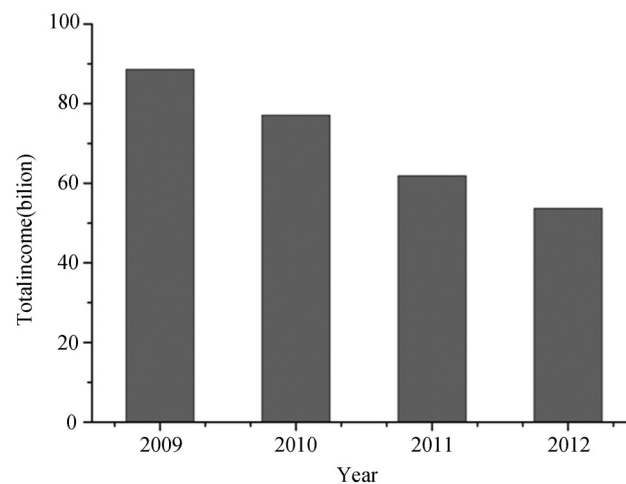**Figure 5**
2003-2012 Number of Customers

Figure 6
2009-2012 Total Annual Income

Figure 5 shows that the number of customers who went to Internet cafe in China from 2003 to 2012. The number comes from the Ministry of Culture of the People's Republic of China (2012). There were no more than 20 million people went to Internet cafe for a variety of reasons in 2003. The absolute number of customers who went to Internet cafes looks like so huge, but the population base is large in China. So the proportion of the population going to Internet cafe was low. The quantity of customers increased within a narrow range in the next two years, and the sheer number of customers was 20.03 million and 29.97 million, respectively. The data increased rapidly and reached more than 40 million in 2006. In contrast to the recent 2007 and 2008, that was not the fastest growth time. There were two main reasons that caused the proliferation of Internet cafe's customers. The first one was the widespread use of electronic commerce, and the second reason was that the Olympic Games were held in Beijing in 2008. That was not only a sport event, but also a kind of political activity. More young people, especially university students went to Internet cafes to know everything about Beijing Olympic Games. The number of customers going to Internet cafe barely grew in 2009. The number of people was 163.15 million, and it reached peak in 2011. From whatever perspective, all numbers were very big. That means more than 10% of population has been to Internet cafe for a variety of reasons in China in that year. The most important reason that Internet cafe attracted the crowd was online games. Many online games included sex and violence as well as know. But China has not had a film ratings system until now. The owners of Internet cafe seek only profits and do not think about bad influences of this kind of online games to juveniles. So many juveniles went to Internet cafe to play online games. The Chinese government has rolled out a range of policies to ban juveniles from going to Internet cafes. It resulted in, in a certain measure, the number of customers decreasing from 2011 to 2012. The data was just more than 120 million in 2012.

Figure 6 is about that the total annual income of Internet cafe industry from 2009 to 2012. The Internet cafe market was worth close to 90 billion yuan of revenues in 2009. The market scale declined every year in the next three years. The total annual income was a bit above 50 million yuan in 2012. Compared to the data in 2009, it decreased 44.4%. There were four reasons leading to this situation. The first reason is that the absolute number of people going to Internet cafe decreased with the popularity of personal computer and broadband. Something that used to be done in Internet cafe before has no need for going to Internet café, like playing online games—people could play it easily at home or other places. So a part of people chose net play at home with better privacy and environment. The second reason is that more and more people had smart phones. No matter net

playing, online reading, listening music, or watching TV, people could also achieve through smart phone. The third reason is that rent and human cost has risen sharply, and it caused operating cost of Internet cafe rising. Therefore, the annual income would reduce.

Similarity could be found from three different kinds of data. Development of Internet cafe slows down in recent years after a fast growing period. Matured technology and new policies always affect whatever Internet cafe amount, customers, and total annual income.

8. WHAT IS THE FUTURE OF THE ICT INNOVATION? AND WHY?

Through this investigation about diffusion of Internet cafe, I find that there are two elements which influence adoption or diffusion of a new information and communication technology innovation. One is that purely technical element; another is that stress or policies which come from society or governments. Anyone needs to take long time to accept or recognize.

When a new information and communication technology innovation is introduced to the public at the beginning, often only few people can realize its real value. Meanwhile, it is just these people who extend the new technology to a bigger area. This process happens again and again; finally this new information and communication technology innovation would be widely accepted in the world.

In the process of extending of a new information and communication technology innovation, society or government, both of which are powerful, would notice negative impacts of this innovation little by little. After all, no one is perfect. Society will stress this innovation to change better; the result is probably a new innovation based on this one. Government will make policies to restrict the shortage of this innovation and ensure reducing negative to minimum. The result could be the same as above, but also could thoroughly destroy this innovation.

In the future, influence of ICT innovation to society will be deeper and deeper even by a small innovation, because information and communication technology has been an important part of social life, economic life, and political life. Looking back 30 years ago, nobody can imagine the changes brought by the Internet. Thinking about last several decades, how many ICT innovations have been created? 2G mobile phones, 3G mobile phones, alarm systems for homes, automatic Teller Machines, CD Players, Community Technology Centres, Desktop computers for business use, Desktop computers for personal use, Digital cameras, and DVD players. . . all these can prove that ICT innovation brings us huge impacts. According to the China Internet Network Information Centre (2013), there are 59.1 million people using Internet in 2012. It cannot be imagined that the first

e-mail from China to the world was sent in 1987. This also can prove the point of view above.

CONCLUSION

Rapid development of Internet technology leads to the possibility of Internet cafe as a kind of industry. Diffusion of Internet cafe has reached everywhere in the world. Internet cafe has the bottle-neck of development, like everything else. Development of Internet cafe today reaches a peak at its history, especially in China. These restrictions are not because of technical elements but because of the political elements from the government.

All policies that are mentioned above aimed at Internet cafe directly. In fact, some other policies that look like having no relationship with Internet cafe could also influence the diffusion of Internet cafe. The most obvious example is the birth control that has skewed China's population and caused aging. As everyone knows, the main consumer group of Internet cafe market is young people. Population aging means the number of customer is reduced. It is not an obvious reason but could act on the development of Internet cafe indirectly.

When Internet cafe cannot meet expectations of government, it means challenges are coming. When Internet cafe beats these challenges, it can evolve itself to a certain extent. It is not the right attitude to disavow that Internet cafe cannot get another big diffusion. After all, diffusion of Internet cafe depends on not only policies from government but also technology innovation.

However, it must wait for another excellent chance of ICT innovation.

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