

Analysis of the Open Source Software Sector in China

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Summary

The paper describes the status and context of the Chinese Open Source Software (OSS) industry and ecosystem based on the analysis of the components of the China OSS Promotion Union. The analysis involves comparisons of several main Chinese developers of Linux operating system and makers of open source counterpart of the popular Microsoft Office package as well as several main Chinese OSS communities. Comparisons concern the technological and business aspect. The findings reveal peculiarities of the divergence of innovative activities of Chinese companies, as well as indicate that the strong government support may at the same time limit the technology selection under rigid competition, especially as foreign open source companies are found to be more focused on hobbyist developers and are able to maintain larger independent communities.

Implications of the paper include the need to coordinate global development efforts and adjust science & technology policies in order to stimulate both the development and the diffusion of open source among Chinese companies and individual hobbyists.

Key Words: open source software, technological capability, business model, community, China

1. Introduction

Open Source Software (OSS) attracts nowadays attention of academics, government representatives, hobbyist developers and commercial companies, as a proven and innovative approach to technology development and an interesting business model. Chinese OSS industry is usually described as the largest market for OSS in the world. There are many OSS dedicated companies and communities sourced by government and hobbyists. However, there are still substantial limitations due to the relatively closed nature of innovation of technologies and business models of Chinese communities and OSS companies. It will therefore be interesting to analyze

the communities and companies as main actors of the OSS ecosystem in China.

The objective of this paper is to identify the peculiarities of the technological capabilities and business models adopted by Chinese companies, as well as reveal the role of communities and to present certain policy recommendations to stimulate the innovation of Chinese software industry.

The paper is structured into five sections: the following section will discuss the evolution and nature of OSS and present a literature review concerning OSS. The next section will present respectively the conceptual framework, research questions and research methods. Section 4 will describe the Chinese OSS software industry. Section 5 will discuss the related research findings, including the analyses of ecosystem of Chinese OSS industry, several main Chinese developers of Linux operating system, makers of open source counterparts of the popular Microsoft Office package, and the role of communities. The concluding section will summarize the findings and discuss their implications for science and technology policies in order to foster the growth of the Chinese OSS industry.

2. The Technology and Business Background of Open Source Software

2.1. Definition of OSS

Free/Libre/Open Source Softwares are terms most commonly used in the literature. According to the Free Software Foundation, an established software rights management organization, free software can be defined as “a matter of the users' freedom to run, copy, distribute, study, change and improve the software”. More precisely, it refers to four kinds of freedom, for the users of the software:

- The freedom to run the program, for any purpose (freedom 0).
- The freedom to study how the program works, and adapt it to your needs (freedom 1).
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to improve the program, and release your improvements to the public, so that the whole community benefits (freedom 3).¹⁾

Open source can be understood as weaker forms of distribution of the source code than free software in a very strict standard (Fuggetta, 2003).

1) See: <http://www.fsf.org/licensing/essays/free-sw.html>.

However, open source does not just mean access to the source code - the official definition of what constitutes open source software or the open source model sets some specific criteria, as clarified by the definition by the Open Source Initiative (OSI)²⁾.

2.2. Evolution and Dynamics

The open source model had its roots in academic computer science more than a decade ago. In general, open source refers to any program, source code of which is made available for use or modification by users or other developers. Historically, developers of proprietary software have generally not made their source code available.

Open source software is usually developed, tested or improved through public collaboration and distributed, with the idea that the software be shared with others, to ensure an open future collaboration. The collaborative experience of many developers, especially those in the academic environment, in developing various versions of the UNIX operating system and the desire of users to freely choose among a number of products have led to the open source movement and an approach to developing and distributing programs as open source software.

The idea of open source software is not very new; actually in the early stage of software industry, the software source code was freely distributed without any licensing restrictions until the antitrust decisions forced companies to unbundle hardware and software layers and standardize them, leading to code closure and software commercialization. The Open source movement is just like a renaissance in software industry at this point.

Since Linus Torvalds developed the first Linux release in 1991, over 300 distributions of Linux have been created. Each distribution nevertheless consists of the core Linux system, so-called "kernel", and some underlying GNU³⁾ tools. Important parameters differentiating various systems are the graphical user interface, license type, bundled application software, availability of the source code, and whether a vendor has established, promoted and maintained a developer community on its website.

The authors are of the view that the following illustrates the dynamics of open source movement. The first aspect is the enormous number of hobbyists along with flourishing communities. With the booming Internet and huge developer networks in many projects, more and more hobbyists take part in projects of different communities and more and more software products are being

2) We can get some in-depth criteria of the OSS from the <http://www.opensource.org/docs/definition.php>. Actually, the official definitions done by opensource.org and Free Software Foundation are very close.

3) This is encapsulated under the GNU GPL: the GNU General Public License, which allows people to share and alter software under its aegis.

developed. The second element is the striking success of a variety of OSS led by Linux and Apache, which managed to achieve significant shares in their respective markets. The third development is the involvement of leading IT companies such as IBM, SUN, Oracle, or HP. One of its main reasons could be the fact that the OSS model keeps the costs of development and testing relatively low. Some of the companies take OSS as a business strategy and open the source code of their software; others make R&D efforts related to OSS. Finally, public institutions, especially governments, remain a pivotal factor in promoting the use and development of open source.

2.3. Distinctive Features of OSS

According to innovation theory, even the most secure monopoly can be overwhelmed by a new idea, technology or shift in tastes (Schumpeter, 1934). OSS as a mode of software development could be regarded as the kind of disruptive innovation or even revolution, changing the traditional software technology development, business operation and business model.

In sharp contrast to proprietary/commercial software development, the OSS model is an essentially new paradigm of software development with a different organizational structure, development process and ideology/culture (Raymond, 2000a Moody,2001; Sharma et al., 2002). In the famous book - "The Cathedral and the Bazaar" (Raymond,2000), Raymond discussed the differences between Open Source Software and traditional proprietary software development models by using the metaphors of cathedral and bazaar. The traditional software development is hierarchically structured, as opposed to the distributed, chaotic, but also more innovative OSS development (See Table 1).

The community has the pivotal role in the open source movement (Dahlander, et al.,2005). The hobbyists in the communities are committed to different projects. Taking the world's largest OSS development project hosting site - SourceForge.Net- as an example, now there are 115,497 registered projects, involving 1,270,905 registered users.⁴⁾

4) By 16th Mar. 2006

Table 1: Difference between Open Source Software and Proprietary Software

Comparison	Open Source Software	Proprietary software
Development model	Distribution, and interaction through the Internet	Strictly organized through software engineering and process control
Version release	Frequent and rapid	Released in fixed time
Source code	Open source under GNU or other licensing model ⁵⁾	Closed source code
Testing	Dedicated testing department	Freely tested by users or communities
Management model	Collaborative efforts	Top-down control
Focus	Users	Authors (business developers)
Supported by	Communities and OSS companies	Software companies

Note: This table is heavily influenced by Raymond (2000).

What should be noticed is that such a model makes the development and testing costs very low, while the quality of OSS could be equal or even better than the quality of proprietary software with similar functionality (Samoladas, et al., 2004).

Attracted and inspired by preceding features of OSS, many large IT companies began adopting OSS as a new technology development and a business model. Even Microsoft, threatened by OSS at large, has started its "shared code" initiative, involving limited source code opening to partners and client organizations. Generally, the open source movement has changed the traditional organizational structure, development process, technology strategy and business models along with great success of OSS companies and striking profit gained by the industry leaders through such a model.

2.4. Past Studies on OSS

As a flourishing industry, OSS has attracted the attention of many researchers. The economics literature on OSS focus mainly on the individual incentives to participate in open source projects, the incentives of firms to adopt open source initiatives, the business models of firms operating within the open source landscape, and the competitive implications of open source software (Economides and Katsamakas, 2005).

5) See the detail at <http://www.gnu.org/licenses/gpl.html>

Many past studies are focused on the issue of motivations of hobbyists, such as enjoyment and learning (Lakhani et al., 2002). or getting access to funding for future software ventures (Lerner and Tirole, 2000). The incentives of firms should include making money on complementary services, keeping abreast of open source movement, and embracing an open source project to preempt the development of a standard around a technology owned by a powerful rival (Lerner and Tirole, 2001).

Krishnamurthy argued that OSS gives any interested party access to the source code, leading to a distributed innovation model in which users actively participate in the product's development. On the other hand, OSS leads to a proliferation of versions, and may appeal only to high-end (Krishnamurthy, 2003).

Based on the study of the evolution of open source networks in industry, De Laat (2004) argued that over time, the open source inspired networks developed by traditional software companies tend to gradually resemble traditional corporate networks. From the point of view of intellectual rights, Pearson (2000) studied the effect of open source licenses on commercial software development and discussed the dynamics of OSS.

Some researchers (Fuggetta and Alfonso, 2003) believe that the open source paradigm is one of the most promising strategies to enhance the maturity, quality, and efficiency of software development activities. Based on innovation theories, Grand et al. (2004) argued that open source movement presage the third models of innovation besides the innovation models within firm boundaries or in the public arena. Mustonen (2003) suggested that the occupational choices of programmers based on reputation incentives determine the qualities of programs. He also explained the simultaneous existence of commercial and copy left⁶⁾ programs, like Windows and Linux, and deemed that commercial alternatives to copy left programs may not exist.

Using the concept of "user innovation" to study the community, Von Hippel (2001) argued that in the case of OSS, innovations can be produced and distributed essentially for free on the web because methods of distributing user innovations for information products, general distribution within and beyond the user community are carried out by the community itself.

To explain the success of OSS, with the theory of technology diffusion with network externalities, some researchers argued that commercial software and OSS are likely to co-exist in the future (Bonaccorsi and Rossi, 2003). Based on the two case studies of Apache and Mozilla which are two of largest open source projects, Mockus, et al.(2003) indicated many ways in which elements of commercial and open source processes could be combined, and new approaches

6) The opposite of copyright, with which everybody entitled to use the intellectual property without restrictions.

that would elegantly combine the best technologies from all types of software development environments. Our study contributes to this literature stream by characterizing the structure of Chinese open source software industry as a whole focusing on some local open source companies (not large IT companies which many researchers have studied) and communities from the viewpoint of sectors and national levels. In spite of substantial interest in Chinese open source by international scholars, there are few studies focused on the OSS industry of developing countries like China (Shen, 2005). We intend to fill the gap in empirical findings, focusing on the whole ecosystem of Chinese industry.

3. Methodology to Analyze the Chinese OSS Sector

3.1. Conceptual Framework

The preceding sections have reviewed the past studies concerning the open source movement, revealing major actors and relative functionalities in the OSS sector. Based on this perspective, the OSS sector could be understood as a set of different actors, such as OSS traditional companies OSS communities OSS associations and government agencies, which interact with one another within a sector, just like in an ecosystem (See Table 2). Considering the important roles played by hobbyists, we include them as a part of this framework.

Table 2: Actors in the OSS Sector

Actors	Definition	Examples
OSS Companies	Dedicated in open source software related products	Redhat, Turbolinux
Traditional companies	Mainly IT companies potentially adopting open source	IBM, HP, SUN
OSS Communities	Dedicated in developing and diffusing OSS related knowledge	Debian, FreeBSD, Gentoo
OSS Associations	Dedicated in diffusion of OSS	The China OSS Promotion Union
Government Agencies	In charge of OSS related policy	Ministry of Information Industry, Software & IC Promotion Center
Hobbyists	Community members	

Under the proposed framework, main interactions among these actors include cooperation and corresponding knowledge diffusion, which include opening source code of originally closed software to communities, adopting OSS of communities, policies and corresponding actions on companies, associations, communities and universities from government, funding of communities by OSS/traditional companies, associations and even hobbyists, as well as available knowledge diffusion brought in by hobbyists, transferred between different organizations.

3.2. Research Questions

Under the proposed framework, the open source movement could be regarded as a disruptive innovation, signaling some interesting questions related to the Chinese OSS industry. The main research questions we attempt to address are:

- Q1. What is the structure of the ecosystem (roles of actors, scale, scope and pattern)?
- Q2. What are the technological capabilities and business models of the main OSS companies and communities within this ecosystem?
- Q3. What are policy implications for stimulating the growth of Chinese OSS industry?

3.3. Research Methods

The analysis of the structure of the OSS sector reveal important aspects of technology strategies and business models, as well as demonstrate the inter-organizational differences and the divergence of innovative activities of companies and communities.

The analysis investigates the largest relevant association, the China OSS Promotion Union (COPU) as a sample since the union consists of almost all Chinese OSS players⁷⁾. The analysis focuses on the structure, distribution, features and scale of these member organizations. The qualitative and quantitative data sources include: 1) statistics and bulletins of COPU; 2) corporate literature, annual reports, promotional materials and websites of companies and communities; and 3) business and trade press reports.

The analysis of Chinese OSS companies, which leads to a better understanding of companies' behaviors in terms of technology and business aspects, consists of two parts. In the first part, the authors adopt a hybrid approach to analyze the Chinese Linux companies' technological capability and the business models. In the second part, in order to compare the OSS model and traditional proprietary software model, we focus on the leading companies in the Chinese

7) See the introduction of the China OSS Promotion Union at http://www.oss.org.cn/index.php?option=com_content&task=view&id=27&Itemid=54.

office software sector and intend to find why OSS based office software could not succeed in the same way as Linux market. The qualitative and quantitative data sources include: 1) business and trade press reports, 2) corporate literature and reports of companies, and 3) interviews with two Linux companies.

Here we focus on the communities developing specific projects, because they clearly possess certain innovative capabilities and generate knowledge, whereas those communities without software development projects contribute more to the diffusion of technology and knowledge than creation according to the analysis of Chinese OSS communities. In this part, technology and business model will be presented. The data was obtained from websites of those communities.

The further analysis is based on the preceding findings, and reveals threats to the Chinese OSS industry, as well as implications for government policies to stimulate both the development and the diffusion of open source among Chinese companies and individual hobbyists. However, there is limitation on this analysis of detailed technology and business strategies adopted by local OSS companies and communities, because the paper focused on the whole system of the Chinese OSS industry based upon few interviews with companies and communities.

4. Main Findings from the Analysis

4.1. OSS Market Led by Linux

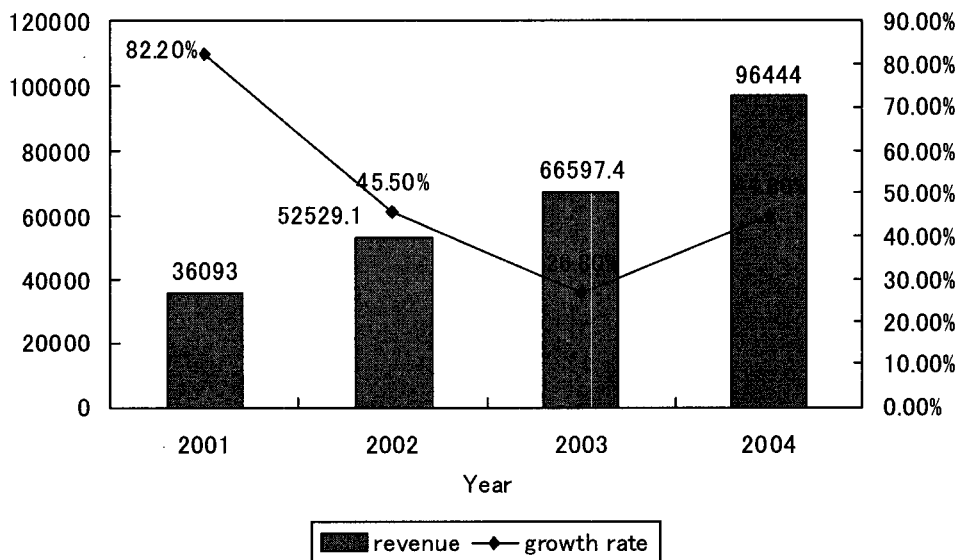
As many researchers from academia and industry predicted or argued, the open source movement gradually become dominated by Chinese-speaking developers. Seemingly, China is emerging as one of the most important providers of OSS and related IT services as well as a large OSS consuming market.

It is difficult to identify when open source software entered China. It probably began with first Linux distributions, brought back to the country by returning exchange students. In the early 1990s, there were only few pioneers in Chinese universities and public research institutes, using or developing Linux-based software. In 1997, the International Free Software Application Research Development Sub-council was set up by the Chinese Software Industry Association (CSIA), alongside with the first OSS repository (freesoft.cei.gov.cn)⁸⁾. OSS concepts were officially introduced by the government in 1999. Since then, many OSS (mainly Linux-related) communities and companies emerged.

8) Now it is not available.

Linux was inspired by the popular UNIX operating system, but designed to run on a variety of platforms. Linux can be used for many purposes, including networking, software development and as an end-user platform. The Linux kernel uses no proprietary source code. It was and still is developed cooperatively primarily on the Internet by a large group of volunteer who they exchange code, report bugs and fix problems in an open-ended environment.

So far, as the most important and prominent OSS, it can be argued that nowadays Linux is almost equal to the OSS on the whole in China: most Chinese OSS-related activities are focused on the development of the operating system. As Figure 1 shows, by the end of the year of 2004, the revenues of Linux vendors reached the level of 96.444 million RMB compared with 36.093 million RMB 3 years earlier.



Note: unit is thousand RMB.
Source: CCID 2005

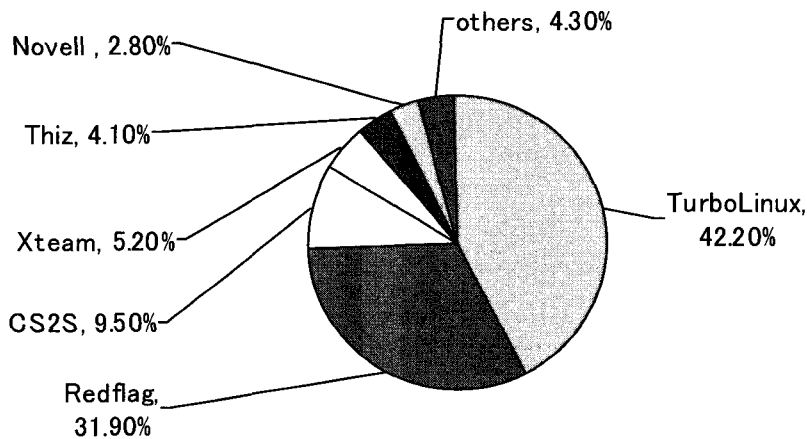
Figure 1: Chinese Linux Market, 2001-2004

In the Chinese OSS industry, local companies such as Red Flag, Turbolinux (originally a foreign company, now controlled by Chinese capital), CS2S, Xteam and Thiz, dominated the Chinese Linux market (see Figure 2), having the competitive advantage of understanding the home market, adopting localization strategies and offering adequate price levels. Their success was also largely due to substantial government purchases.

At the same time, the foreign Linux companies such as Redhat and Novell, have entered

the Chinese market and also gained a phenomenal success with good brand names and more mature technologies. In the beginning, most Linux companies focused on the Client Operating Environment (COE) rather than the high-end Server Operating Environment (SOE).⁹⁾ However, they encountered many obstacles, facing the lock-in effects from Microsoft and changed the emphasis towards the server market. Consequently, their profits from SOE increased (see Table 3).

The data presented leads us to the conclusion that Linux is currently the main OSS in China, a limited number of local companies dominating the market. The market of Linux servers (SOE) is likely to be more important than that of Linux clients (COE) so far.



Source: CCID 2005

Figure 2: Chinese Linux Software Market: Main Players in 2004

Table 3: Linux Software Market Structure 2004

(Unit: RMB)

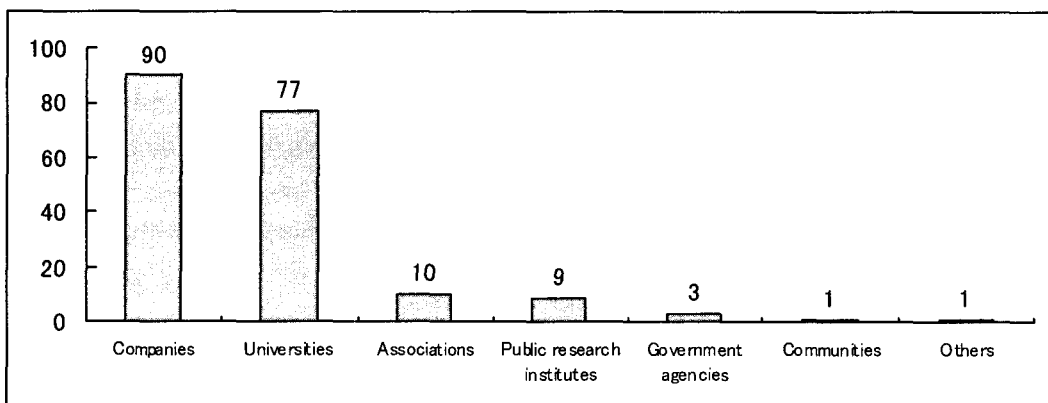
	Linux Client Operating Environment	Linux Server Operating Environment	Total
Revenue	14,537.3	8,1906.7	96,444
Market share	15.1%	84.9%	100%
Growth rate (Compared with last year)	39.1%	45.9%	44.8%

Source: CCID 2005

9) This classification is from IDC, see IDC Report: Market Analysis China Linux 2005-2009 Forecast and Analysis by Nielse Jiang.

4.2. OSS Ecosystem

The China OSS Promotion Union (COPU)¹⁰, an industrial organization under the Ministry of Information Industry (MI), was set up in 2000 under the government's initiative for promoting cooperation between OSS firms, research institutes, main players in software, hardware and telecom industries, major customers, and other relevant organizations. The union includes almost all of the OSS players, reaching 191 member organizations in January 2006.



Sources: Bulletin of COPU and other secondary data.

Figure 3: Chinese OSS Ecosystem: Distribution by Member Organization

According to Figure 3, there are 90 companies and 77 universities, but only one independent developer community (Debian: www.debian.org : an international community). This scarcity reveals two important facts. The one point is that communities are still as grass root and can not attract attention of mainstream players yet. The other point is that there may be no signs of partnership or other forms of cooperation between communities and commercial companies.

On the other hand, the wide participation of Chinese universities in the association could have a tremendous impact on the OSS diffusion thanks to the modification of curricula in the education system in China. For further analysis, the member companies are divided into two groups, supply-side and demand-side, as Table 4 shows.

10) See http://www.oss.cn/index.php?option=com_content&task=view&id=27&Itemid=54,

Table 4: Chinese OSS Ecosystem: Types of Member Companies

Supply-side		Demand-side	
Linux OS firms	12	Banks	8
Linux-based application developers	35	Telecom equipment makers and telecom operators	7
Other OSS-related firms	7	Hardware makers	5
Foreign IT companies	4	IT services firms	7
Total	58	Total	27

Note: 5 companies could not be classified.

Sources: Bulletin of COPU and other secondary data.

On the supply-side, there are 47 Linux-related firms and only seven other OSS-related firms, which confirm the asymmetrical phenomenon of Chinese OSS industry. There are four foreign IT companies, including BEA, IBM, HP and SUN, adopting large-scale open source technologies, paying more attention to OSS than local IT companies.

On the demand-side, there are eight banks, seven telecom firms, five hardware makers and seven IT services firms, which reveals the narrow scope of applications in those fields of OSS in China. By contrast, in many other countries OSS is also used in broader fields, including education, telecommunication, manufacturing, entertainment and so on. It is also partly due to the limited application developed by supply side. The problem asks for the more complex and business-critical applications. The distribution of Chinese OSS Ecosystem highlights the dominant role played by Linux in the OSS sector of China. The strong Linux momentum can be gauged from the number of Linux related companies.

In addition, the Chinese government has actively promoted the use of Linux, and encouraged software companies to develop dedicated applications for the platform (with office software discussed as an example late in this paper). The incentives of the government can be explained as follows: OSS could be exploited by government as an opportunity to enhance the general capability level of the Chinese software industry. OSS could be taken as an opportunity to break away from the technology dependence on foreign companies and standards, and to create local innovations.

4.3. Adoption of Technologies and Business: Linux Firms in China

For the detailed analyzes of innovation strategies in technology and business, eight leading

local Linux companies were selected. As Table 5 shows, these companies' Linux products adopt different technology pathway. The network map (Figure 4) describes technological dependencies between components, bundled with Linux distributions, representing also implicit technology partnerships among companies and communities¹¹⁾.

The analyzed companies adopt many versions of Linux kernel. Only Turbolinux, Co-createLinux and SW-linux adopt the latest version of kernel, whereas the other Linux products still based on the 2.4 version of kernel, which means slower reaction speed to latest technologies. Six of those companies claim to have developed their own Linux distributions¹²⁾ except for SW-linux (based on Debian) and Chineselinux (based on Redhat). However, on the other hand, different versions of Linux may no longer be compatible, which might influence the development of related application and slow down the growth of the Linux market.

Table 5: Technology Offering of Leading Linux Companies in China

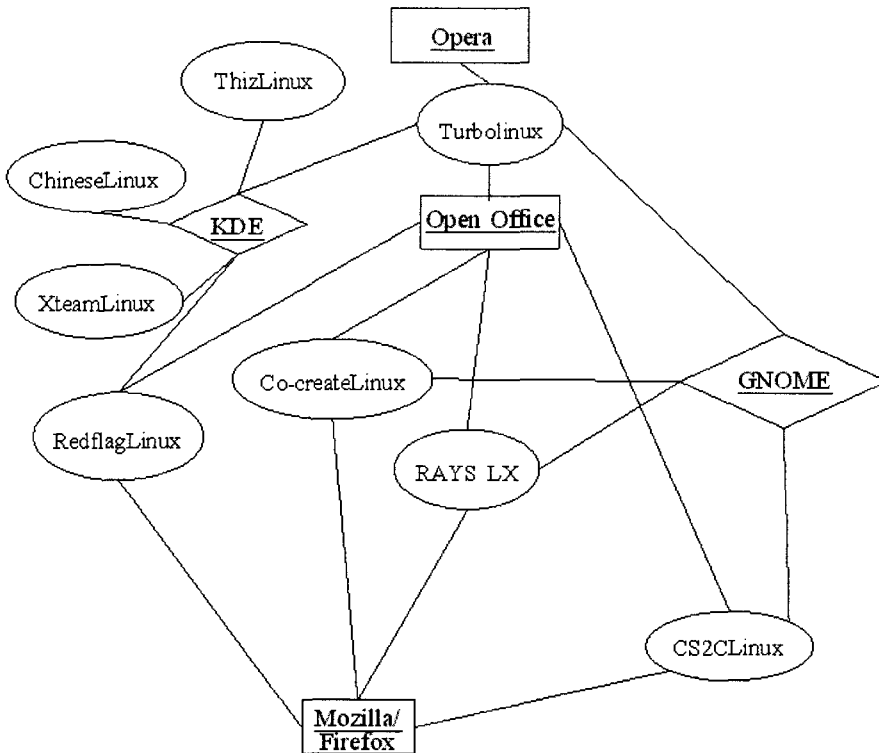
Company Name	Turbo-linux (China)	Red Flag	CS2C	Co-create	Thiz	Xteam	SWL	Chinese 2000
Latest Linux Desktop Product	Turbolinux 10 Desktop	Redflag 4.1 Desktop	CSLinux Desktop2.0	Co-Creat Desktop Linux 2005 V2.0	ThizLinux Desktop 7.0	Xteam-Linux 3.2	RAYS LX	Chinese-Linux
Kernel	2.6.0	2.4.26	2.4.21	2.6.10	2.4.20	n.a.	2.6	n.a.
Based on Linux Distribution	Turbo-linux	Redflag-Linux	CS2C-Linux	Co-crate-Linux	ThizLinux	Xteam-Linux	Debian	Redhat
Graphical User Interface	KDE 3.1.5 GNOME2.4	KDE 3.2.X	GNOME 2.6	GNOME 2.6	KDE 3.1	KDE	GNOME 2.6	KDE
License Type	GNU/GPL	GNU/GPL	GNU/GPL	GPL /LGPL	n.a.	n.a.	GPL/ LGPL	GPL
Bundled Free Open Source Components	Glibc , Gcc XFree86 xFce, Rpm Openoffice Opera	Xfree86, Glibc, FireFox Perl, QT, OpenOffice	XFree86, Glibc, Evolution, Mozilla, OpenOffice	Firefox, Thunderbird, OpenOffice	RPM, Xfree86	RPM, KoOffice	OpenOffice, Mozilla	RPM, KaiOffice
Availability of the Source Code on the Website	No	Yes	Yes	Yes	No	No	Yes	No
Maintaining Developer Community on the Website	No	Yes	No	Yes	No	No	Yes	No

Notes: SCn indicates simplified Chinese and TCn indicates traditional Chinese
Sources: Corporate literature and various reports of companies.

11) In theOSS world, software licenses do not require signing formal agreements to include components in own products.

12) See: <http://www.linux.org/dist/list.html> by Mar. 23th of 2006, there are 374 distributions.

As for the selected graphical user interface, four companies adopted KDE, three selected GNOME, and one (Turbolinux) included both interfaces. All companies use the GPL or LGPL licenses, complying with the OSS requirements and keeping the system open to public. There is not so much difference with their main application software. Most companies adopted Firefox or Mozilla as web browser (both are very similar and coming from the same developer community), except for Turbolinux that adopted Opera (see Figure 4). The Asian language support is almost same (although Turbolinux also has Japanese version, which is due to the international background of Turbolinux), showing the focus of Chinese Linux companies on the local market. They use OpenOffice as office application software, which corresponds to the importance of OpenOffice in the global OSS market¹³).



Notes: ○ : Linux companies
 □ : adopted open source application
 ◇ : adopted Graphical User Interface
 Sources: Corporate literature and Reports of companies

Figure 4: Network of Technological Interdependencies between the Leading Linux Companies in China

13) Kaioffice adopted by Chinese 2000 is also developed basing on OpenOffice.

Linux source code cannot be freely downloaded from the websites of some companies (Turbolinux, Thiz, Xteam, Chinese 2000) – the cases evidence the tendency to restrict the access to traditionally open and widely available software and attempts to derive private benefits from intentionally public goods, but at the same time the companies are still compliant with the requirements of the software licenses they use. There are no independent developer communities, maintained by the companies, except for Red Flag, SWL and Co-create – while a developer community is usually the key stimulating the development and diffusion of open source.

Table 6 also shows information related to the business models of the analyzed companies. In general, these companies operate mainly in Linux-related business. At large, they began focusing on the enterprise application domain. It could be attributed to the rigid competitive pressures in the Microsoft-dominated desktop (client) market. As many researchers suggested, the quasi monopoly of Microsoft Windows creates lock-in of computer users. These lock-in effects on the client side are related to the familiar user interface, working habits, and standards. On the other side, in the enterprise application market, especially in the server market, lock-in is not so strong and financial motivation to look for Microsoft alternatives is substantial, which could be an important reason why the Linux vendors focus on this particular market.

Another interesting point is that CS2C, Co-create, Red Flag and Thiz have all developed their own branded office software based on OpenOffice. That product strategy could be explained by two viewpoints. One is that Linux-based application software is a key in selling the Linux operating system. The other takes into account low development costs because the companies in question are merely modifying existing open source software. Their main partners or investors are foreign firms, including IBM, HP, Intel or Sybase, which demonstrates the importance of software market globalization and of external technology sources.

Table 6 also revealed that the government is a very active customer for Chinese Linux companies. Apart from the government, educational organizations also play a very important role, promoting and diffusing the technology among users and practitioners in universities, high schools and other educational organizations.

With regard to technology strategies and business models of Chinese Linux companies, some weakness could be identified:

- 1) Different version of Linux may not be compatible, which influences the development of related application;
- 2) Limited innovativeness may lead to homogeneity in products' functionalities.
- 3) Similarity of the strategies and product offerings of the firms may shift the competition from functionalities and innovations towards costs or customer relations only.

Table 6: Products and Business Focus Areas of Chinese Linux Companies

Company	Main Linux Related Products	Focus Market	Other Business	Main Partners or Investors	Main Customers
Turbolinux (China)	Turbolinux10 desktop, Turbolinux Enterprise Server 8, Turbolinux7 DataBaseServer TurboHA Server 6.5	High-end enterprise application	n.a	CA, Dell, HP, Intel, IBM, Oracle, Pervasive, Sybase, Lenovo, Dawngroup, AFS	Banking, Telecom, Energy sources, Traffics, Post, Internet Government, Education
Red Flag	Redflag 4.1 Desktop Red Flag Advanced Server 4.1 Redflag DC Server	Moving into enterprise application from desktop application	RedOffice (developed by affiliated firm)	Balkone, BEA, CA, Dell, EMC, HP, IBM, Intel, NEC, Oracle, SAP, Sybase, Symantec, Dawngroup, Founder, LangChao, Lenovo, PowerLeader, TCL	China Post, Chinese Academy of Sciences, Government, Universities, China Tobacco
CS2C	CSLinux Desktop2.0 CS server, CS Mail server CS Database server	Desktop and enterprise application	Neoline Office(Under the license - SISSL)	Pervasive, IBM, Intel: Rising, Stengzhou, Basesoft, Tongte, Neusoft, Browserstar, Boksyan, Lenovo	Government, Banking, Universities
Co-create	Co-Create Desktop Linux 2005 V2.0 Co-Create NC Solutions	Desktop application	Co-create Office (Under the license-SISSL)	IBM, Novell(SUSE), Sybase, NTT Data	Government, OEMs
Thuz	ThuzLinux Desktop 7.0 ThuzServer 7.0	Desktop and enterprise application	ThuzOffice (Under the license-SISSL) ThuzAnti-Virus Thuz Fire wall	ASL, Intel, IBM/HP, Oracle, Sybase	Government, SMEs, Educational organizations and individual users
Xteam	XteamLinux 3.2; XteamServer 5.0; Xteam Postal Server 6.0	Enterprise application	n.a	HP Lenovo	Government, Educational organizations
SWL	RAYS LX 1.5; Embedded software	Enterprise application	Web tools	n.a	n.a.
Chinese 2000	ChineseLinux V1.0	Desktop application	n.a	Redhat, Borland, IBM, Shaolin, Redflag	Government, Educational organizations

Sources: Corporate literature and Reports of companies

- 4) Dependence on government purchases would limit the strategies and potential diffusion in other markets.
- 5) There is little relationship between companies and communities whereas foreign open source companies are found to be more focused on hobbyist developers and maintain larger independent communities.

4.4. Case of the Office Software Sector

As described above, OpenOffice¹⁴⁾ is the most popular open source office software. Its successful diffusion should also have a positive effect on companies, releasing modified versions of OpenOffice technology under their own brand names. By the end of 2004, the overall revenue of office software sector in China reached the level of 559 million RMB and increased at a rate of 25.6%, compared to the revenue of 2003. That rapid increase can be attributed to government purchases (see Table 7) and the launch of new product versions by Microsoft, Sun, IBM, Kingsoft, Evermore and other vendors.

Table 7: Chinese Office Software Market 2003-2004

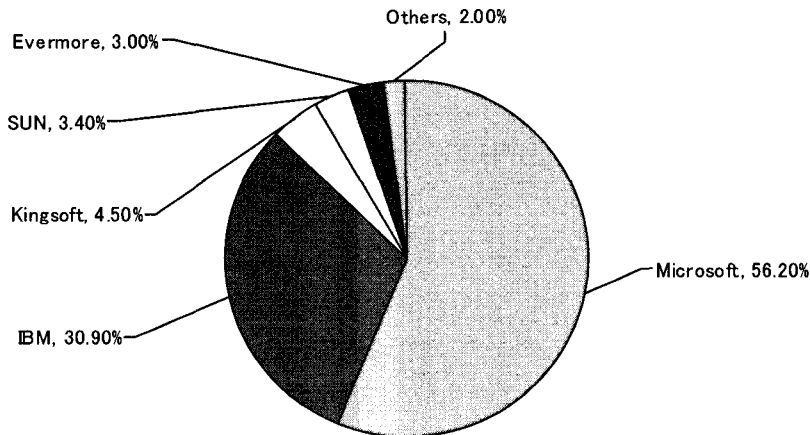
(Unit: million RMB)

	2003	2004	Growth Rate
Educational organizations	53.85 (12.1%)	68.38 (12.2%)	27.0%
Government	91.23 (20.5%)	122.19 (21.9%)	33.9%
Individual users	33.38 (7.5%)	38.68 (6.9%)	15.9%
Large companies	164.64 (37.0%)	204.13 (36.5%)	24.0%
SMEs	101.91 (22.9%)	125.61 (22.5%)	23.3%
Total	445.01 (100%)	558.99 (100%)	25.6%

Source: CCID (2005).

14) See <http://www.openoffice.org/>

Figure 5 demonstrates the breakdown of the office software market. Foreign companies including Microsoft, IBM and Sun, hold over 90% of the market. The leading local companies are Kingsoft (4.5% share) and Evermore (3.0% share), but their proprietary products are not based on the open source OpenOffice¹⁵).



Source: CCID (2005).

Figure 5: Chinese Office Software Market by Major Companies

There are many office software products derived from open source technologies as Table 8 shows. The local companies developed their products compatible both with MS Office and OpenOffice to eliminate possible inconveniences. They also made their products suitable for both Windows and Linux environments to eliminate the operating system dependence. Thirdly, apart from the standard functionality of MS Office, they also offered some new features, such as an improved webpage editor, an additional database or automatic transformation of texts between traditional and simplified Chinese.

However, these innovations are limited and could not be a decisive factor, leading to the market success. The market problems of OSS office vendors might be attributed to at least three factors: 1) strong monopoly of large foreign companies, even though local companies have cost and price advantages 2) homogeneity of local office software products, influencing their market positions 3) users' working habits, discouraging the switch from MS Office to other software packages.

15) The latest of Kingsoft's office software "WPS Office V6" was developed internally by the company, similar to the greenfield development of the Evermore's Office.

Table 8: Chinese Office Software Products Based on OpenOffice

Company	Latest office software product	Operating systems	Interface similar to:	Functionalities
Kingsoft	Kingsoft Storm Office ¹⁶⁾	WindowsLinux	OpenOffice	Word, Excel, Powerpoint, save as PDF, compatible with MS Office
Redflag Chinese 2000	RedOffice	WindowsLinux	MS Office	Word, Excel, Powerpoint, save as PDF, Database, compatible with MS Office
Thiz	ThizOffice	Windows&Linux	OpenOffice	Word, Excel, Powerpoint, PDF, drawing and photo editor, webpage editor, compatible with MS Office
Kaisource	KaiOffice	Windows&Linux	MS Office	Word, Excel, Powerpoint, PDF, drawing and photo editor, webpage editor, compatible with MS Office
Co-create	Co-create Office	Windows&Linux	MSOffice	Word, Excel, Powerpoint, compatible with MS Office
CS2C	Neoshine Office	Windows&Linux	MS Office	Word, Excel, Powerpoint, compatible with MS Office

Source: Corporate literature and various reports of companies.

Findings from this analysis imply that to overcome these problems, Chinese local companies should adopt more diversified technology and business strategies. The education organizations and government should have an important market focus to eliminate the lock-in effect brought by strong monopoly of large foreign companies.

4.5. OSS Communities

In spite of the substantial number of OSS-related communities in China, there are not many developer communities. Most of the so-called "OSS communities" are actually rather platforms for discussing technologies than project development platforms, in which the hobbyists can exchange their opinions or get the latest news concerning OSS. In many cases, the community websites provide also downloads of popular software. The user communities should be a good platform for the diffusion of innovations. However, as many studies show, in the open source movement, developer communities are more important in both the creation and the diffusion of new products and technologies.

¹⁶⁾ It must be noticed that the Kingsoft Storm Office is not the most important of the office software products offered by Kingsoft - the company also has its proprietary, non-open source offering in this area.

Table 9: Open Source Software Communities of China

Communities	Year founded	Focus	Number of projects	Number of developers	Linux-related Products	Based on Linux distribution	Supporters /Sponsors	Organizing Form
OpenDesktop.net	2002	Desktop	19	58	Opendsktop OS Two versions: free and paid	Co-create Linux	Co-Creat	Management committee
Hiweed	2004	Desktop Server LiveCD ¹⁷⁾	No project plan	n.a.	Hiweed Linux	Debian ¹⁸⁾	hobbyists	Individual
www.magiclinux.org	2003	Desktop	3	18	Magic Linux	MagicLinux	hobbyists	Management committee
B2D	2004	Desktop Server LiveCD	7	2	B2DLinux	Debian	hobbyists	Individual
CLE	1998	Extending Linux in Chinese	10	15	ChineseLinuxExtension		hobbyists	Individual
Gentoo China	2002	LiveCD	4	7	Ibox	Gentoo	hobbyists	Individual

Sources: Corporate literature and Reports of companies

17) A LiveCD is an operating system (usually containing other software as well) stored on a bootable CD-ROM that can be executed from it, without installation on a hard drive. See: en.wikipedia.org/wiki/Live_CD

18) They are now considering transfer to Ubuntu- another kind of Linux distribution.

Table 9 presents several typical Chinese open source developer communities. They are still in the "budding" stage, when users join and establish communication and cooperation patterns, not very active in terms of the number of projects and contributing developers. What should be noticed is that most of the communities did not get any support from commercial companies or other organizations in terms of funding or technology transfer, which could limit the creation and diffusion of innovations. The organizational forms, lacking structured processes, roles and decision making mechanisms, may also hinder their further growth.

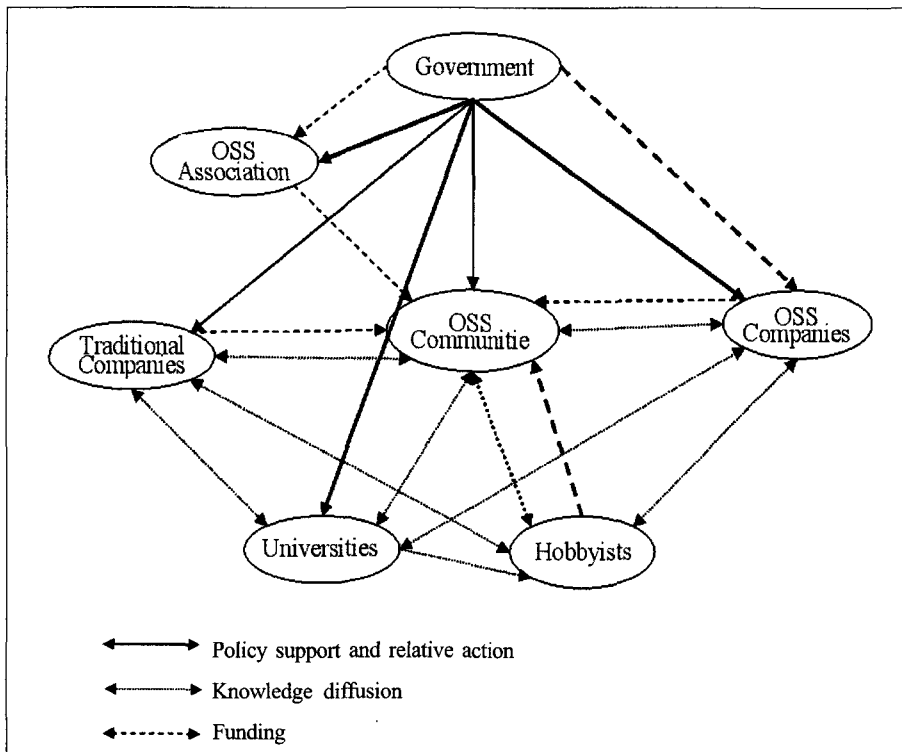
5. Concluding Remarks

Based on the conceptual framework presented in section 3 and the analyses carried out, the states status of Chinese OSS ecosystem could be described in Figure 6. Firstly, with respect of policy support and relative action by government, the OSS communities are ignored whereas the OSS companies and universities are supported by the government. Secondly, with respect of knowledge diffusion, we could not find any clear evidence showing the knowledge diffusion between companies and local communities, which would influence the growth of innovation in the local software sector. Thirdly, with respect to funding, the communities hardly get funding support from companies or government, which would keep the role of communities in a weak position.

The research reveals also potential threats to the Chinese OSS industry such as.

- 1) Both government and industry put too much emphasis on Linux, which is only one of many kinds of OSS. This may lead to an asymmetry in resource distribution. The preceding analysis shows that there are not many other OSS-related companies or communities and Linux remains the main focus of the industry.
- 2) The OSS communities are still very weak and small. The preceding analysis showed that there are few projects and developers. Most of the communities did not get any support from companies or other organizations in terms of funding or technologies - as opposed to the tendencies in American and European OSS markets. Similarly, the individual organizational forms and management patterns of communities demonstrate the limitations of innovation development and diffusion.
- 3) The largest IT companies, such as SUN or IBM, joined the OSS group and exploited the OSS in their business models and marketing strategies, so that the OSS may actually become a threat rather than an opportunity for local small and medium software vendors.

- 4) Dependence on government's purchases and limited scale of local OSS operations might undermine the development of the Chinese OSS industry. They will likely be challenged by larger foreign OSS vendors, competing for the same contracts with more advanced products. The strong government support may at the same time limit the technology selection under rigid competition, especially as foreign open source companies are found to maintain larger independent communities.
- 5) Open source-related policies of the Chinese government and development activities of local communities are focused on developing the basic functionality and substituting commercial solutions such as operating system or Office software - while in other countries, open source is also used as a licensing model for more complex, business-critical applications.
- 6) Chinese OSS companies/communities seldom maintain communications with overseas communities or companies, which means that they miss a crucial advantage of the global OSS industry.



Note: Thickness of the arrows symbolizes the importance of links.

Figure 6: Ecosystem of Chinese Open Source Software Industry

Above described picture leads to the following implications. Firstly, comparing the position of Windows in desktops, a situation unlikely to change, the future of Linux server platform will be much more promising within the market of Linux. Government should take more actions to stimulate the Linux server application diffusion among enterprises and other organizations.

Secondly, considering the limitations due to the closed nature of innovation strategies of Chinese companies and communities, there is an urgent need to coordinate global development efforts. Almost all of the successful international communities involve the hobbyists all over the world.

Thirdly, government should make efforts to rationalize the utilization of OSS rather than just emphasize the diffusion of Linux. Now that OSS worldwide offers an open source industry chain, covering most software-related field, as an alternative to commercial, proprietary solutions, it can be utilized by policy makers in China.

Lastly, communities' growth should attract more attention due to the role of communities in the typical OSS ecosystems. The government should find interest in stimulating the growth of communities by co-funding them and supporting the technology development.

OSS has provided a great opportunity for the global software industry, especially to countries with undeveloped software industries. In China, there are high expectations for OSS, which should offer cost reduction, security enhancement, promotion of competition, and the development of the domestic sector, narrowing the distance between developed countries and enabling the leapfrog of the national software industry. It may be a very effective way of building up self-developed software entities and absorbing foreign investment and technologies, providing that the OSS industry development process is well-balanced and benefits from the spontaneous participation of hobbyist developers, as well as inter-organizational linkages and knowledge exchanges.

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- The Open Source Definition, at <http://www.opensource.org/docs/definition.php>