Innovation in virtual networks: evidence from the Chinese online game industry

Yimei Hu and Olav Jull Sørensen
Centre for International Business Economics, Department of Business and Management, Aalborg University, Aalborg, Denmark

Abstract

Purpose – The purpose of this paper is to explore and highlight the particular innovation characteristics and modes of the Chinese online game industry from a networking perspective.

Design/methodology/approach – This research is qualitative. Both primary and secondary data are used, which is collected through desk research on related documents and long-term participative observation and personal experiences. This paper begins with an overview of the online game industry's innovation process and types; then constructs a framework that contains four innovation modes with different networks to guide the analysis and organization on the empirical findings; finally, the paper proposes some implications for companies and government.

Findings – This paper is an attempt to open the black box of the innovation of the Chinese online game industry. Born as an incomplete and virtual product, the innovation modes evolve from closed to a combination of open and networking ones. Producer-driven Innovation Network Mode shows that game companies can get innovation resources through its focal network. Producer-user Interaction Mode shows that players' have tremendous innovation potential. Open Collaborative Network Mode shows that power is distributed and the roles of actors are blurred.

Originality/value – This paper offers an analysis of the Chinese online game industry from the innovation side and partly fills the research gap. Also, this paper emphasized the users' innovation ability and a hybrid of different innovation modes, which can be seen as a successful theory test of user innovation, innovation networks, and open innovation theories in the Chinese context.

Keywords Innovation networks, Producer-driven innovation network, User innovation, Open innovation, Online game industry, Innovation, China

Paper type Research paper

1. Introduction

With 384 million "netizens" by the end of 2009 (CNNIC, January, 2010), industries related to the internet enjoy an exceptional advantage, so does the Chinese online game industry. Without a long history, the online game industry in China has already shown tremendous economic potential and has become the leader among all the Chinese entertainment industries. This innovative industry's development triggered our interests and we could not help wondering: What is inside of the innovation "black box" of the online game industry? However, the academic world has not given this industry enough attention. More research is still remaining on the video game industry (see Gallagher and Park, 2002; Aoyama and Izushi, 2003; Storz, 2008) and in the case of China, researchers who have studied the Chinese online game industry focus more on operation issues, revenue model, business model and social influences (see MacInnes and Hu, 2007) and there is little research on the innovation of this industry (see Cheng *et al.*, 2004). Thus, there is a gap to fill.

Journal of Knowledge-based Innovation in China
Vol. 3 No. 3, 2011
pp. 198-215

1756-1418
DOI 10.1108/17561411111167863

In conventional research, companies were seen as the drivers and in control of innovation and the users' tremendous innovation potential has been underestimated and even ignored until the 1970s, when Eric von Hippel (1986) and his research team proposed the importance of users as part of the innovation process. Furthermore, the innovation process shows a more and more open collaborative and networking trend (Freeman, 1991; Baldwin and von Hippel, 2009). The online game industry is virtual, and development is not based on the consumption of natural resources but based on knowledge and innovation. Within the online game industry, we can clearly see different innovation modes being combined and interacting with each other. Within different innovation modes, more and more actors rather than producers have participated in and thus through the interaction of different actors, innovation networks are formed, which have been regarded as a new trend of how innovation is organized and analyzed.

This study will discuss different innovation modes of the Chinese online game industry from a networking perspective. The aim of this study is to try to understand "What are the characteristics of innovation in Chinese online game industry? How can we understand different innovation modes from a networking way and how can we learn from it?" The study focuses primarily on the user innovation modes based on long-term observation of and engagement in the online games and the internal innovation synergy as well as the interaction between different innovation modes.

The paper is composed as follows: After the introduction, Section 2 provides a brief review of the literature on the related innovation theories; Then, an overview of the online game industry in China is provided (Section 2) followed by the framework of the study and the presentation of four different types of innovation modes in the Chinese online game industry (Sections 4-6); The study will conclude with a few proposals on how to manage and stimulate the innovation abilities of users and other network actors (Section 7).

2. Literature review

2.1 From closed to open innovation

From the beginning of the twenty-first Century, open innovation theory has been promoted. Chesbrough proposed that the philosophy of closed innovation, i.e. successful innovation requires control, were no longer suitable for the twenty-first century since it was no longer easy for firms to control the mobility of knowledge workers as well as their proprietary ideas (Chesbrough, 2003). Open innovation is a paradigm that assumes that "firms can and should use external ideas as well as internal ideas and internal and external paths to market, as they look to advance their technology" (Chesbrough, et al., 2006, p. 1).

As a relatively new theory, open innovation research is an ongoing process though there has been massive paper on it. Chesbrough (2004) used an interesting metaphor to discuss the new metrics to manage innovation, i.e. from playing chess to poker. He suggested that a firm should focus more upon external sources of innovation to enhance its business model and this would enable the firm to salvage value from false negatives that otherwise would be lost. Laursen and Salter (2006) used a large-scale sample of industrial firms and discovered that searching deeply and widely was curvilinear (U-shaped) related with innovation performance. A similar U-shaped relationship has been discovered by Wincent *et al.* (2009) as well. West and Gallagher (2006) identified three fundamental challenges for firms in applying open innovation. Also, they answered why firms would spend money on R&D efforts if the results

of these efforts are available to rival firms by examine the activity of firms in open source software and identified four strategies firms employ to meet the challenges. To conclude, open innovation is about seeking external sources, so it naturally means collaboration, alliances and networks. In Section 2.3, open innovation in networks will be mentioned.

2.2 From producer innovation to user innovation

The producer is mostly the focal unit of analysis and seen as the driver of the innovation process in most innovation theories. They are motivated to innovate by the expectation of profits and intellectual property rights that give them exclusive control over the innovations, even if the innovation has emerged from participating in various networks. However, two increasingly important innovation modes are the user innovation mode and the open collaborative innovation mode (Baldwin and von Hippel, 2009). They did not give a clear definition on "innovation mode", but here we think innovation mode shows the driving force of innovation and the way of knowledge generating.

Users or the interaction between users and producers have always been an important part in the innovation network theory (Freeman, 1991) and customers even have become one of the most sought-after innovation partner (OECD, 2008). According to Baldwin and von Hippel's summary in 2009, Enos, Freeman, von Hippel (1986), Pavitt, Shah, Morrison *et al.* (2000), Christina Raasch, *et al.* and others have provided evidences in support of the innovative potential of users. Here, the user is defined as firms or individual consumers that expect to benefit from using a design, a product or a service (von Hippel, 2004). Among the innovative users, there are lead users who bring about the trend of "democratization of innovation" (von Hippel, 2004). They are defined as:

- anticipate obtaining relatively high benefit from a solution to their needs and so may innovate; and
- lead users are at the leading edge of important trends in the market place under study and so are currently experiencing needs that will later be experienced by many users in that market place.

The definition of lead users is in line with the concept of opinion leaders in the innovation diffusion theory. Individuals or customers show differentiated innovativeness in different innovation diffusion steps (Rogers, 1995). Some consumers, which are regarded as opinion leaders (Rogers, 1995; Kleiner, 2003), achieve particularly influence, authority and legitimacy among peers and thus are responsible for the diffusion of innovation information and usage experience.

In 2003, Jeppesen and Molin (2003) mentioned, however not in detail, that online game firms rely on an external consumer community for innovation. In this paper, users, or say online game players' innovation will be discussed in detail.

2.3 From linear innovation to virtual network innovation

Since the 1980s, the innovation process has been gradually regarded from a linear process to a network one (Håkansson, 1984; Imai and Baba, 1984). In the early 1990s, Rothwell (1994) divided the innovation theory into five generations of modeling innovation and indicated the coming of a generation of innovation in networks. Freeman (1991), DeBresson and Amesse (1991), Bianchi and Bellini, Soh and Roberts and Powell used

the concept "networks of innovators" to illustrate innovation by interpersonal, intraorganizational and interorganizational actors. Furthermore, many theories, such as national systems of innovation (NSI), Triple Helix, open innovation, user innovation, use a network perspective to discuss innovation. For example, Gelsing used the concept of industrial networks as a description of sub-systems of national innovation systems. Etzkowitz (2002) used concepts such as network of innovation, networked incubators to discuss the relationship between university, industry and government. Open innovation scholars discussed open innovation in interorganizational context, knowledge networks and value networks (Chesbrough *et al.*, 2006, pp 205-258). von Hippel discussed horizontal innovation networks and user communities (von Hippel, 2004) in the user innovation theory.

The concept of "network" becomes so popular, but there is no consensus about the appropriate definition of networks. Also, it is hard to say whether innovation network is a virtual context which firms construct and embedded in, or if it is a unique organizational design of firms (Betts and Stouder, 2004). Networks are often characterized with the concept of "loose coupling": various independent actors develop relatively loose relationships to pursue some common goals; network relationships are characterized by mutual interdependence, intensive communication, reciprocity and trust (Burt, 2000). Generally speaking, a network is made up of individuals or organizations (nodes, actors, stakeholders), which are related by one or more types of interdependences (Freeman, 1991).

As the development of information and communication technology, the virtual reality of innovation networks emerged, i.e. virtual networks. Similar concepts are virtual organization, virtual enterprise and virtual business. That is to say, organizations can be operated with a more fluid, flexible management practices (Rogers, 1995). Here, virtual means: geographically distributed; electronically linked; functionally or culturally diverse; and lateral connected (Pedersen and Nagengast, 2008). Virtual organizations and virtual networks are quite common and more literatures are providing the positive evidence of this trend, e.g. Gwebu *et al.* (2007); Latapie and Tran (2007); and Pedersen and Nagengast (2008).

One research stream of innovation networks focuses on networks internally in an organisation (intraorganization) and the other one focuses on relations between autonomous organisations (interorganization). Internal innovation network requires the integration and coupling of R&D, production and marketing functions within an organization. External innovation network focuses on linkages with external sources of knowledge and innovation. Based on actors, centrality, duration, formality, location and openness, there are many types of innovation networks. In this study, we will not discuss firms' intraorganizational networks and will focus on these types of innovation networks: focal online game firm's network; user networks; and open collaborative network. The above networks are virtual, since the communication and innovation are in digital forms and take place mainly online.

2.4 Open collaborative innovation network and hybrid of innovation modes

Baldwin and von Hippel developed a term called "open collaborative innovation" (2009), which can be seen as a development of both open innovation and network theories. An open collaborative innovation involves contributors who share the work of generating a design and also reveal the outputs from their individual and collective

design efforts openly for anyone to use, e.g. open source platform (von Hippel and von Krogh, 2003). The participants are not rivals with respect to the innovative design (otherwise they would not collaborate) and they do not individually or collectively plan to sell products or services incorporating the innovation or intellectual property rights related to it. The open collaborative innovation can be also seen as a flexible, informal and virtual network or knowledge pool, you can freely access and you can change your identity from innovator, communicator, producer, or stander-by.

Hybrids and combinations of different innovation modes become a trend in reality, because nowadays a big innovation project can be divided into several modules and each of the modules could fit a different innovation mode. Different modules can be worked separately and simultaneously from different places and thus collaborative design of an innovation project is possible (Baldwin *et al.*, 2006; Baldwin and von Hippel, 2009). Also, since the development of an online game can be divided into different steps, hybrid of innovation modes can be introduced.

3. Overview of the online game industry

3.1 Development of online game industry in China

Online game is quite different from traditional PC games or video games. Essentially, the online game has different product attributes. It is a new game system, which restore the nature of a game, i.e. the interaction between people, not the interaction between the individual and computer. Second, the profit of online game industry is based on long-term paid service, while the main income of PC game industry is from the sales of the game pack (CD-ROM or pay downloads). Third, after launching into the market, the PC game software is difficult to revise. In contrast, the online game will always be an "uncompleted product", which can be revised and improved from time to time.

The launching of "The King of Kings" in 2000 showed the formation of the Chinese online game industry. By the end of 2009, the Chinese online game industry increased by 39.5 per cent compared to 2008 and the market sales reached to 25.8 billion RMB, which was far more than the film industry with market sales of 6.2 billion RMB (Ministry of Culture of P.R.C., 2010). During the last decade, the Chinese online game industry has already achieved a transition to independent innovation. About 115 new online games were put on the market in 2009 and 80 of them are based on independent intellectual property rights (Ministry of Culture of P.R.C., 2010). The leading online game companies include SNDA, Netease, TencentSoft, PerfectWorld, GiantGame, The9, Sohu, Kingsoft and Netdragon and these core companies in total has a market share of around 90 per cent of the whole industry. At the same time, more and more innovative small and medium size enterprises (SMEs) are entering the industry, including lead users that turn into game producers.

3.2 Development and updating process of an online game

The development and updating process of an online game can be divided into six steps as shown in Figure 1, with different innovation modes integrated inside. The first step is the overall idea and design of an online game, its plots, etc. Game designers will gather ideas from others through their network resources. Thus, this step is usually relatively open, which is indicated by the dotted line in Figure 1 and will not be discussed any further in this study.

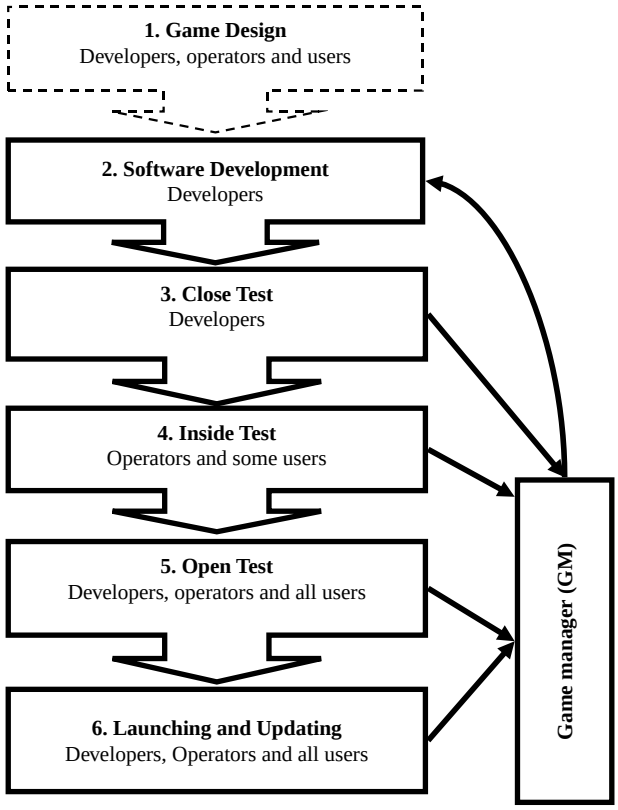

Figure 1.
The development and updating chain of an online game

After the game design, the next step is to develop the software and test it. Software development and close test will normally be done in-house by developers to keep confidentiality. In inside test, some users may join in. After that, the online game is made available to the public to run the open test, which will usually run for one to three months so that players can get well acquainted with the game and report back on any bugs. When major bugs are eliminated, the game is launched on the commercial market. The users may continue to report bugs and the game developer may also update the game technically or with new elements to make it more attractive. Figure 1 indicates that the innovation process is linear. This is not the case. Each stage in Figure 1 could be repeated several times.

Turning to the actors involved, a key actor is of course, the developer, who designs the game and who is also involved in the updating of the game. Another key actor is the game manager (GM). As we can see from Figure 1, bugs and flaws discovered in the process (step 3 to 6) will be collected by the GM and then reported to the developer. The operators are companies which operate the online game after its launching and they usually take part in several round tests of online games as well. Users can also be game testers and sources of new ideas. All six steps may be integrated in one and the same company, or be fragmented with each of the steps carried out by a separate company.

However, generally speaking, all online games are developed along these six steps though one or two rounds of tests may be skipped.

3.3 Types of innovation

In this section, we will classify innovations within this industry by their degree of innovation and whether the innovation is technical in nature or is related to the content of the game. Table I combines four types of innovations into a simple matrix, i.e. radical, incremental, technical and content. Here, technical innovation of the online game means the innovation or revision on the software and program itself, while the content innovation mainly deals with the story of the game.

Four cells in Table I show different combinations of innovation types as well as examples. The radical innovations in cell A and B are normally capital and knowledge intensive and although ideas and inspirations for radical technical innovations as well as content innovations may partly come from users, the expectations are that these innovations will be producer-driven. In case of the incremental innovations, the users are expected to play a more important role. The innovation modes are thus expected to be different in the different cells.

4. Analytical framework and the research methodology

4.1 Theoretical framework

Based on the identified characteristics of the online game industry in China and the understanding of innovation theories, we construct a framework with four innovation modes that we believe is appropriate for this industry:

(1) The Producer Centered Innovation Mode.

(2) The Producer-Driven Innovation Network Mode.

(3) The Producer-User Interaction Mode.

(4) The Open Collaborative Network Mode.

Only the first innovation mode is closed, the others are, to a varying degree, open innovation modes. The Producer Centered Innovation Mode is the classical one, where innovation takes place in concealed labs.

	Technical innovation	Content innovation
Radical innovation	A Fundamental change of an online game: development of new game engine; transition from 2D game to 3D game; application of new human-machine interaction technique; new server and link mode	B Develop a new online game with new plot or gameplay without fundamental change on the game engine:, e.g. different online games based on the ancient Chinese epos *Travel on the West* by the Netease Company
Incremental innovation	C Revising technical and software problems: fixing program bugs; fight against game plug-ins; adjust the audio-visual effects	D Revising game contents: bring in new game plots or activities; balancing the abilities of different characters in the game; purifying the game environment

Table I.
Classification of innovation in the online game industry

The Producer-Driven Innovation Network Mode is a mode with the producer still in control and it selects who to interact with. Thus, it can be seen as a virtual network controlled by a focal firm.

The customer networks of a game company can be a strategic asset (Shanker and Bayus, 2003). The Producer-User Interaction Mode is a mode where users are more like partners who have their own agenda that must be taken into account for the partnership to succeed.

Finally, the Open Collaborative Network Mode is a mode where the border lines between producers, users and other actors become more blurred. The virtual network as such possesses the resources and competences to produce and operate online games and the actors participate in network activities and take actions that are purposeful and in general results in win-win.

4.2 Research methods

This study will mainly use qualitative research methods and focus is on the interaction between actors on the inter-organizational level. When analyzing the producer centered and producer-driven innovation network, secondary data will be used. The data were collected from related literature, research reports on the online game industry, web sites of online game companies and many other related web sites.

When discussing the producer-user interaction and open collaborative innovation modes, the primary sources of data are primary data. These data are collected either from long-term engagement in the online games and participatory observation or from the personal communication and interviews with other online game players. Based on the personal online game playing experiences in the past several years, the high level of creativity of grass roots and individuals in the online game industry was discovered. Furthermore, primary data were collected by communicating and involvement in the lead users' circle through instant messaging, email, personal spaces and on-line forums. These provided opportunities to observe, how knowledge and information are generated and shared among users.

Thus, the study is based on triangulation of data collection methods, using both secondary data and data from own gaming activities and membership of and participation in web sites dedicated to the discussion of online games as well as data from observations, dialogue and interviews with game users. The experiences and the data from interviews are documented by ways of online discussion records, personal online game WebPages and experience sharing passages as well as comments.

5. Findings from the Chinese online game industry

5.1 Producer centered innovation mode

This closed innovation mode happened when the online game industry was totally new in the beginning of twenty-first century. At that time, knowledge needed to develop an online game was concentrated in some early online game companies. As a result, it was not possible for developers to search innovation resources from outside the company. A typical example was the development of "JX Online", which was the first Chinese online game with self-owned intellectual property. The developing group of the Kingsoft Company with 44 people carried out the design, test and operation of the game from 2000 to 2003. After the success of early online games, the innovation mode is changing to a relatively open one.

5.2 Producer-driven innovation network mode

In this mode, the development of online games is based partly on in-house resources and partly on linkages to various external sources related both to technical and content innovations. The online game company, acting as the main driver of innovation process, normally constructs a focal network around the company to strengthen its existing knowledge and gain complementary ones from other actors. Also, this is the choice of many big online game companies.

Table II provides an overview of the typical actors constituting the network around a producer innovator and in this section, each actor's role and different dyadic relationships will be discussed.

Producer-government relationship. In China, the government is an important actor in the online game industry. The Chinese government uses different policy instruments to regulate and promote this sunrise industry. The Chinese government has published a series of regulatory policies to avoid certain side effects of using the games such as internet addiction, pornographic and violent contents of online games, private servers and game plug-ins and cut-throat competition among firms.

From the promotion side, the Chinese government has shown foresight and made great progress in promoting the development and innovation capabilities of this industry. First of all, the Government has provided support to the self innovation projects, bred the competence of domestic companies and promoted international cooperation. The "863 Program", which can be seen as the Chinese version of EUREKA, is a support program focusing on important industries. In 2003, the online game industry was included in the "863 Program" at a time when this industry was seen as "poisonous",

Actors within the online game network		Relationship and innovation function
Government		Regulation and promotion
Related industries	Media and Publishing Houses	Giving ideas on the game design, developing online game supportive products and services
	IT and Telecommunications Industry	Providing the infrastructure; cooperation on mobile online game; mutual shaping and promotion
Online game firms	SMEs and R&D groups which are specialist on one or more online games activities	Draw support from these small firms by acquisition and merging, investment or contract
	Big Domestic Companies	From competition to cooperation: "Baotuan"
	Leading Foreign Companies	From following and imitating to competition and cooperation
Service institutions	Financial Institutions	Financial support
	Support firms or institutions	Consultation, information sharing, relationship sharing
Universities and Research Institutions		Cooperation on R&D, talent cultivation
Users		User innovation mode: Innovative push; lead user innovation; opinion leader's information diffusion and sharing

Table II.
Relationship between the online game producer and actors within the innovation network

meaning that its side effects were criticized by society. One project was given to a collaborative project between the Automation Institute of Chinese Academy of Sciences and SinoHome, a game company. This was an important milestone and offered a good example of cooperation between government and industry. Besides, Chinese Government supported the establishment of "game industry parks" all over China, especially in the less developed western part of China. The biggest game industrial base is now located in the ancient city of Chengdu in the southwest of China. Moreover, the Chinese Government is always willing to show the online game industry to the world by international cooperation of any type. For example, the annual ChinaJoy exhibition has become a world famous mutual entertainment exhibition.

Producer-supporting industries relationship. Supporting or complementary industries are the media, publishing, IT, telecommunications and financial industries. The IT and telecommunication industries by providing the infrastructure and hardware facilities, are born as complementary industries to the online game industry, i.e. they mutually influence and shape each other. With the development and implementation of new internet access facilities, online game companies broaden their product assortment. For example, the popular online game "The world of legend", developed by SNDA, launched a mobile edition of the game together with China Mobile and China Unicom. The mobile edition can share the data with the online edition, which marked a milestone for the Chinese online game industry – a big step in the development of wireless mutual entertainment technology.

Media and publishing industries are also good innovation partners for producers. The development of these industries offers inspirations. For example, some popular online game themed stamps are published and popular novels or films are recomposed to online games, or vice versa.

Collaboration within the industry. Cooperation with companies inside and outside China has turned out to be a new trend, as expressed by the CEO of SNDA: "Baotuan" (embracing a group) will replace the strategy of "do it alone" and will develop new opportunities for the Chinese industry[1]. There are three trends: collaboration with foreign leading companies; invest or collaborate with domestic SMEs; and collaboration between domestic main competitors.

First, in the past, the Chinese online game companies were the operators of foreign games, but nowadays, some Chinese online game companies begin to cooperate with foreign leading companies on R&D, through project collaboration, strategic alliances, investments and mergers and acquisitions. For example, SNDA established a long-term friendship and the strategic cooperative partnership with the world's leading online game developer and operator, NCsoft from South Korea in 2007.

Second, based on complementary advantages, the leading Chinese online game companies collaborate with newly burgeoning SMEs or technical teams, which are creative and have core technologies. For example, the Kingsoft Company invested in "Lianjin Studio" who developed the 3D game engine called Alchemy and established a new joint venture aiming at cooperation on R&D.

Third, the Chinese leading companies which used acting in isolation, have started to collaborate. In January 2009, SNDA's user platform was linked to Kingsoft's new game "JX online 2" and the two companies began to operate the game together. This strategic cooperation opened a new cooperative era for the leading companies of the Chinese online game industry.

Universities, research institutes and other organizations. Universities and research institutions are the source of talent. With the popularity of online games, more and more universities began to set up related majors and departments. In addition, cooperation between industry and universities on R&D is still on a low scale but on the increase. Various supporting firms and NGOs help to collect and transfer valuable market information. Some of the intermediaries are also the derivation of a government function and again have special functions such as consulting and accounting companies.

5.3 The producer-user interaction mode

In the Producer-Driven Innovation Network Mode, online game companies, who control more innovation resources and choose their partners, stay in a relatively centralized and dominant position. However, as the knowledge of other actors increase, the dominant power of the producer decrease and other actors' status emerge, including that of the users. The purpose of this section is to analyze the interaction between users and producers, the co-construction of online games and the user innovation.

Lead users. The investment of time varies a lot among different players[2], which indicates that there are different categories of players and thus the game producers cannot satisfy all of them equally. Some players, who want to meet their needs[3], begin to explore and innovate. Observations from this study show that some players know more about the game than others[4] and it suffices to distinguish between lead and normal online game players.

Based on the previous literature review, it is possible to give a description of lead users in this industry. Lead users, or lead players, are players who spend more time and know more about the online game; who want to try new things in the game; who care more about official updating information of the game and always like to search related news in BBS[5] or web sites; who are willing to express their views and needs to the producers; who are willing and able to solve problems by themselves; and who are the opinion leaders whose suggestions are trusted by other players. Thus, the lead users are also the user innovators.

The innovation by lead users or players can be divided into two; push and pull. From one side, the lead players push the producer to revise and update the game in order to fit the needs of the players. From the pull side, the lead players transfer knowledge to the common players and share their experiences with them.

Lead users' push. The costly update of online game is always pushed by game players. First, online game players are the free game testers and those that discover bugs throughout the life cycle of the online game. Entering the web sites of online games, it is easy to find links called "Bug submitting", where players present the bugs they discovered according to their experiences. The identified bugs will be checked by the game manager or the operator, who will make the necessary update of the game. To encourage players to report bugs, the online game companies will use incentive mechanisms such as in-game items[6].

In contrast, if a player discovers a significant bug, he may choose not to report it. In the short-term, the player may earn a lot by using the bug while playing. However, in an open socialized online game world, his behavior will easily be simulated by others, or he will share his insights with his friends and then the bug will gradually spread among players until the game operators discover the bug. By then, the bug will be revised any way and players who take advantage from it will be punished heavily,

for example, their ID will be blocked from the logging in the game. As a result, lead users, who discover bugs, would tend to report them in time.

Second, lead players may also serve as designers of online games. The single game producer's creativity is limited while the large population of players owns infinite creativity and may inspire game producers. Theoretically, speaking, an online game could last forever and nobody knows when a game comes to an end. As a result, an online game story is co-produced by game developers, operators and players. The innovative designs proposed by players are always user-originated and if game designers respect the proposals by players, they will get their continued support and thus economic benefit. Nowadays, some game companies even invite users to join in the innovation process before the launching, for example, let the users assist in the design the characters and some parts of the main story. Since the lead users who have engaged in the game design and test may become opinion leaders in the future, this is also a good way for the online game companies to promote the new online game from the beginning.

Third, players are rule makers of the game environment. A harmonious game environment is an important factor to the life circle of an online game. Players who behave rudely or cheat others will be blamed and secluded by other players. Furthermore, the lead players, who try to create a positive game culture, may also push the producers to make some changes. For example, lead players advocated that an award be given to players, who help others to accomplish some hard game tasks. As a result, a cooperative atmosphere and tradition was established.

Lead users' pull. Besides, pushing game producers, lead players also share knowledge and experiences with common players through the pulling process. Online games, especially MMORPG games, require long time learning because of the complexity and diversity of playing. The online game operators only give some basic instructions to players, which can be seen as codified knowledge, while more tacit knowledge remains to be discovered by players through the playing of the game. As a result, some creative lead players begin to explore and experiment.

To illustrate the discovery and spread of knowledge, an example from "Fantasy westward journey online" can be used. In this game, every character can choose several pets to accompany and assist in the game. Different pets have different attributes and some of the attributes are explicit, such as the strength, IQ and HP[7], while some are implicit. Growth rate is an implicit attribute, which indicates the marginal attributes when a pet progresses. At first, players were unaware of the implicit growth rate, while gradually, some players found that some pets through the game became stronger than others and there seemed to be an implicit rule guiding the progressing of the pets. As a result, some lead players began to find the formula, which the game company did not tell. The discovery by the lead players began to spread to other players and the once implicit knowledge became explicit, i.e. some lead player shared it with friends; some enthusiastic lead players published this discovery in BBS and forums; some more creative ones even composed a program to calculate. More and more common players knew how to pick better pets with higher growth rates and this became an "open secret". Then, even the online game operators noticed this and offered a revised edition of the program developed by players on the game web site. Then almost every player knew how to use this program to calculate the growth rate of pets. After a few months, the game operators revised the game and the growth rate was no longer hidden,

but clearly shown in the game, that is to say, new players of the game will treat the growth rate as common sense or general knowledge.

In conclusion, within the producer-user interaction mode, we have as shown in Figure 2, two main types of interaction. The first is the interaction between the game company and the lead users who provide feedback to the producers and push producers to improve the game actively. The second is the lead users that interact with the common users both in terms as being the opinion leaders. Furthermore, here we can see the emerging of other actors in the innovation network and producers are not the dominant power, i.e. players are no longer passive receivers and producers are no longer the dominators. The product life cycle is to a large extent determined and directed by players.

5.4 Open collaborative network mode

The literature review indicated a trend towards a more open collaborative innovation network. This means that more actors are involved. In the online game industry this means, actors mentioned in Sections 5.2 and 5.3 can be regarded as engaged in the open collaborative network mode. The differences between the innovation network here and the producer-driven innovation network are: the producer is no longer in control of other actors; knowledge and information flow transfer much faster and broadly; interactions between other actors increase and ideas are widely shared; and the role of each actor blurs as well.

Open collaborative innovation network requires an open innovative environment and certain platform where all actors could communicate. China has witnessed an increase in web sites and companies, which do not operate any online games but only focus on platforms and web sites where players and all other actors within the online game industry can discuss online game related issues. Examples are 17173.com and Duowan.

Through the share of knowledge, game experiences are spread among users; through open communication and discussion, new knowledge is generated. Many players find their coteries from all over China and then form an inter-personal innovation network. Through the open collaborative innovation process, some user products will come out as well, which are walkthrough or experiences proposed by lead users, useful complementary software for online game, game videos or literatures, peripheral product design and some suggestions on the design or future development of game. Some participants will directly benefit from those products themselves and online game companies will purchase or use these user products. Online game companies can also engage in and communicate or co-design with players. Besides, these actors, many research institutions or government agencies will use the huge amount of user recourses to do some surveys or researches as well.

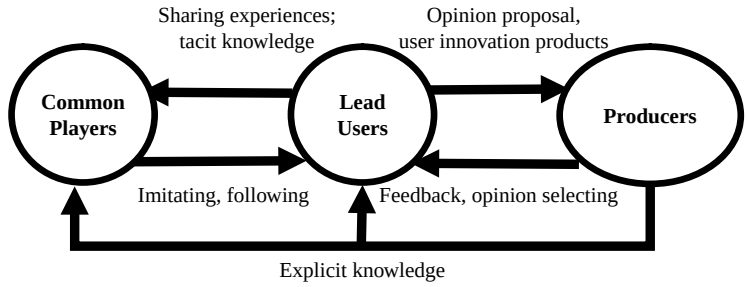

Figure 2.
Interaction between lead users, common users and online game producer and operator

In conclusion, within the network mode, the game industry is seen as a virtual network of actors with various interests in the online game. Each actor can be a contributor to the innovation process of online game industry. Thus, it is hard to say who designed the game, as an online game can be seen as the result of an innovation network. What characterizes such a network is that the power is distributed and only through creating win-win situations, can you benefit from participating.

6. Discussions

6.1 Rethinking the relationship between lead users and common users

Theoretically, rational lead players are not inclined to share their discovery with other common players, while the reality is not so. Why do they codify the tacit knowledge and make their findings public? Judging by appearance, their interests will be suffered, but actually, their "irrational" behavior will bring them reputations and admirations. Their findings may become a standard and they will be acknowledged and respected by other common players because of the first mover advantage. In contrast, sometimes, when lead players try to hide their findings, they will still be simulated, which means their findings are transferred to be explicit passively. As a result, discoveries will be accessible to the public and shared irrespectively of the behavior of the lead users, which is an optimal choice, which can avoid repeated researches and achieve the maximum community welfare.

Further more, referring to the example offered in Section 5.3 on the discovery of growth rate of pets, we can find a clear knowledge transfer process between lead and common users. Nonaka and Takeuchi (1995) proposed the "SECI" model to present the interaction between explicit and tacit knowledge within organization. Here, we regard the users' social network as an organization. At first, tacit knowledge is sensed by some lead users and unlike most common users, they begin to explore and test. After they get a general understanding, they will share with their friends, which is the socialization of knowledge. Next, the tacit knowledge goes one step further and externalized to many players, or say, codified to a clear formula or expression and be understood by all players as an explicit knowledge. Again, the implicit knowledge will be internalized in every player to gain their own understanding. Until the game company discovers the new knowledge and puts the formula on the game web site, we can say that the tacit knowledge has turned into a common sense among players.

6.2 Rethinking the relationship between lead users and producers: entrepreneurial users

The emergence of some lead users has tipped the balance in favor of users. As a result, in an online game producer's innovation network, the user is not only an important actor but also a driving force. Some lead users not only develop their game related products, but may also develop a new career by turning into "entrepreneurial users". One example is the "Xunyou" company which is working on accelerating online gaming speed between different Chinese regions and now it is one of the most successful companies producing online game complementary products[8]. This company is founded by a group of online game lovers, who sensed the business opportunity of accelerating online game. Another example is the "Storm Entertainment", which is the first online game company founded by online game players in 2008. These players had experiences in many online games and the gathered together aiming at developing an online game that can really satisfy players' needs, just as their slogan says: "Good games,

made by players". From this point of view, users begin to consider the benefits and their creativity turns to entrepreneurship.

6.3 Rethinking the virtual network

There is a general trend in innovation to move towards network innovation and we can also observe a trend towards fragmenting the innovation by the use of innovative sub-suppliers: Game operators need not be the game developers; and game developers need not write the game content; game users can be more than players or even game developers, etc. Since the development process and market transactions are virtual in this industry, in an extreme case, all actors can take on dual or triple roles and shift between the roles by a mere click on the mouse.

Within different innovation modes, we can see different virtual innovation networks, i.e. focal firm network, user network and open collaborative network. What is critical in a network is that long-term and trustful relations are established. The study has shown that although online games have the typical features of a good transaction, the participants of the network and notably the lead users are relationship oriented as they can build a reputation through their activities on the online web-sites. Producers as well, they have an interest in acting in such a way that they build long-term relations with the players. Whether we shall call this virtual network "trustful", is doubtful, but it is clear and also documented in the empirical section, that win-loose situations may exist, but it is more likely that win-win situations occur. This again confirms that the online game industry in China (and elsewhere) must be understood and analyzed as a network.

7. Implications and conclusions

As an innovative industry with enormous potential, the Chinese online game industry has achieved remarkable progress during the past decade. However, problems, such as product homogeneity, insufficient innovation, or lack of radical innovation emerge as well. To overcome these problems as well as maintain independent innovation ability, online game companies should learn how to draw support from players. Producers should keep the communication channel smooth and try to use various incentive mechanisms to encourage lead players. Let them join in the test process or even take part in the R&D of the online game and also let them take part in the management of the game operation, such as part time GM or BBS Admin. Besides, producers should respect players' innovative opinion and try to meet players' needs. At last, try to make the online game more customized and thus encourage players' creativity.

More importantly, players need to change their role from passive receiver to positive innovator. Though they may be nobody in real life, they can be heroes and respected by others in the online game world depending on their creativity. Inputs from grass roots can change the whole online game world and the construction of the online game can be driven by players as long as they know how to use channels and platforms.

Besides, producers and users, Chinese governments should be aware of the active innovation passion from grass roots when supervising and promoting the online game industry. One way could be public participation. The government's role will be an important part in the development of the innovation network of online game industry and the NSI.

In conclusion, in principle, everyone can join in the innovation process of the online game industry. The innovation of this industry appears to have a transition from

closed producer centered innovation mode to relatively open innovation modes, i.e. the producer-driven innovation network mode, the producer-user interaction innovation mode and open collaborative network mode. Depending on networks, the online game itself innovates and revises frequently and efficiently. However, this paper focuses more on the qualitative and macro scope analysis, problems such as how to organize different innovation modes to achieve profit maximization within a lower cost, how to pick up useful innovation information in the open collaborative platform and how to manage the communication channels remain to be studied in the future.

Notes

1. In the "Chinajoy 2007" exhibition, Chen Tianqiao, the CEO of SNDA proposed a new collaboration strategy called "Baotuan" for all Chinese online game companies. Available at: http://tech.163.com/09/0326/07/55AIB6FQ000915BF.html (accessed 26 October, 2010).
2. According to the 22nd CNNIC's survey from 2008, the average time players spend on MMORPG games every week is 11.9 hours, while with the standard deviation of 14.3 hours per week.
3. Those players are trying to make them stronger and more popular in the game, make the playing process more convenient, benefit more, or even earn more money from playing.
4. Through long time observation and contacts with those "famous" players, the author found that they will spend more than five hours per day in the online game to maintain their leading positions and even more during the weekends. Based on the author's personal experiences, 12 hours per day can be possible.
5. BBS, or "Bulletin Board System", is a computer system running software that allows users to connect and log into the system using a terminal program. (Wikipedia, available at: http://en.wikipedia.org/wiki/Bulletin_Board_system).
6. In-game item is an object within the virtual game world that can be collected by a player or occasionally from a non-player character and also can be purchased from other players.
7. HP means health point and MP means magic points in online or video games.
8. "Xunyou" has got more than 20 million paying customer and the market share has been more than 60 per cent. More information: www. Xunyou.com

References

Aoyama, Y. and Izushi, H. (2003), "Hardware gimmick or cultural innovation? Technological, cultural and social foundations of the Japanese video game industry", *Research Policy*, Vol. 32 No. 3, pp. 423-44.

Baldwin, C., Hienerth, C. and von Hippel, E. (2006), "How user innovations become commercial products: a theoretical investigation and cases study", *Research Policy*, Vol. 31, pp. 1291-313.

Baldwin, C.Y. and von Hippel, E. (2009), "Modeling a paradigm shift: from producer innovation to user and open collaborative innovation", Working Paper #4764-09, MIT Sloan School of Management, Harvard Business School, Boston, MA.

Betts, S.C. and Stouder, M.D. (2004), "The network perspective in organization studies: network organizations or network analysis?", *Academy of Strategic Management Journal*, Vol. 4 No. 1, pp. 1-21.

Burt, R.S. (2000), "The network structure of social capital", *Research in Organizational Behavior*, Vol. 22, pp. 345-423.

Cheng, J.M.S., Kao, L.L.Y. and Lin, Y.-C.L. (2004), "An investigation of the diffusion of online games in Taiwan: an application of Roger's diffusion of innovation theory", *The Journal of American Academy of Business*, September, pp. 439-45.

Chesbrough, H. (2003), "The era of open innovation", *MIT Sloan Management Review*, Vol. 44 No. 3, pp. 35-41.

Chesbrough, H. (2004), "Managing open innovation", *Research-Technology Management*, Vol. 47 No. 1, pp. 23-6.

Chesbrough, H., Vanhaverbeke, W. and West, J. (2006), *Open Innovation: Researching a New Paradigm*, Oxford University Press, New York, NY.

Chinese Ministry of Culture (2010), "Summary of the white book of Chinese online game market in 2009", available at: www.gov.cn

DeBresson, C. and Amesse, F. (1991), "Networks of innovators: a review and introduction to the issue", *Research Policy*, Vol. 20, pp. 363-79.

Etzkowitz, H. (2002), "Networks of innovation: science, technology and development in the Triple Helix era", *International Journal of Technology Management and Sustainable Development*, Vol. 1 No. 1, pp. 7-20.

Freeman, C. (1991), "Networks of innovators: a synthesis of research issues", *Research Policy*, Vol. 20, pp. 499-514.

Gallagher, S. and Park, S.H. (2002), "Innovation and competition in standard-based industries: a historical analysis of the US home video game market", *Engineering Management, IEEE Transactions*, Vol. 49 No. 1, pp. 67-82.

Gwebu, K.L., Wang, J. and Troutt, M.D. (2007), "A conceptual framework for understanding trust building and maintenance in virtual organizations", *Journal of Information Technology Theory and Application*, Vol. 9 No. 1, pp. 43-63.

Håkansson, H. and Laage-Hellman, J. (1984), "Developing a network R&D strategy", *Journal of Product Innovation Management*, Vol. 1 No. 4, pp. 224-37.

Imai, K. and Baba, Y. (1984), "Systemic innovation and cross-border networks: transcending markets and hierarchies to create a new techno-economic system", paper presented at the OECD, Conference on Science Technology and Economic Growth, Paris, June 1989.

Jeppesen, L.B. and Molin, M. (2003), "Consumers as co-developers: learning and innovation outside the firm", *Technology Analysis & Strategic Management*, Vol. 15 No. 3, pp. 363-83.

Kleiner, A. (2003), "Core groups: a theory of power and influence for 'learning' organizations", *Journal of Organizational Change Management*, Vol. 16 No. 6, pp. 666-83.

Latapie, H. and Tran, V. (2007), "Subculture formation, evolution and conflict between regional teams in virtual organizations", *The Business Review, Cambridge*, Vol. 7 No. 2, pp. 189-93.

Laursen, K. and Salter, A. (2006), "Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms", *Strategic Management Journal*, Vol. 27 No. 2, pp. 131-50.

MacInnes, I. and Hu, L. (2007), "Business models and operational issues in the Chinese online game industry", *Telematics Informatics*, Vol. 24 No. 2, pp. 130-44.

Morrison, P.D., Roberts, J.H. and von Hippel, E. (2000), "Determinants of user innovation and innovation sharing in a local market", *Management Science*, Vol. 46 No. 12, pp. 1513-27.

Nonaka, I. and Takeuchi, H. (1995), *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New York, NY.

OECD (2008), "Open innovation in global networks", available at: http://www.oecd.org/document/43/0,3343,en_2649_33703_41441387_1_1_1_1,00.html (accessed 8 July 2010).

Pedersen, C. and Nagengast, J. (2008), "The virtues of the virtual organization", *Strategic HR Review*, Vol. 7 No. 3, pp. 19-25.

Rogers, E.M. (1995), *Diffusion of Innovation*, 4th ed., The Free Press, New York, NY.

Rothwell, R. (1994), "Towards the fifth-generation innovation process", *International Marketing Review*, Vol. 11 No. 1, pp. 7-31.

Storz, C. (2008), "Dynamics in innovation systems: evidence from Japan's game software industry", *Research Policy*, Vol. 37, pp. 1480-91.

Shanker, V. and Bayus, B.L. (2003), "Networks effects and competition: an empirical analysis of the home video game industry", *Strategic Management Journal*, Vol. 24 No. 4, pp. 375-84.

von Hippel, E. (1986), "Lead users: a source of novel product concepts", *Management Science*, Vol. 32 No. 7, pp. 791-805.

von Hippel, E. (2004), *The Democratization of Innovation*, MIT Press, Cambridge, MA.

von Hippel, E. and von Krogh, G. (2003), "Open source software and the 'private-collective' innovation model", *Issues for Organization Science*, Vol. 14 No. 2, pp. 209-23.

West, J. and Gallagher, S. (2006), "Challenges of open innovation: the paradox of firm investment in open source software", *R&D Management*, Vol. 36 No. 3, pp. 319-31.

Wincent, J., Anokhin, S. and Boter, H. (2009), "Network board continuity and effectiveness of open innovation in Swedish strategic small-firm networks", *R&D Management*, Vol. 39 No. 1, pp. 55-67.

Further reading

Granovetter, M. (2005), "The impact of social structure on economic outcomes", *Journal of Economic Perspectives*, Vol. 19 No. 1, pp. 33-50.

Smith, P.A.C. (2005), "Knowledge sharing and strategic capital: the importance and identification of opinion leaders", *The Learning Organization*, Vol. 12 No. 6, pp. 563-74.

About the authors

Yimei Hu is currently a PhD student at the Centre of International Business, Department of Business and Management, Aalborg University. Her doctoral research is about Danish TNCs' global innovation networks and R&D in China. Before this, she received a Master's degree in Scientific Philosophy and a Bachelor's Degree in Economics from Tsinghua University, China. Yimei Hu is the corresponding author and can be contacted at: yimei@business.aau.dk

Olav Jull Sørensen is a Professor of International Business at the Centre of International Business (CIB), Department of Business Studies, Aalborg University. He initiated the establishment of the centre in 1984, including the MSc program in International Business. The centre is globally connected with university partners in developed, developing, and transition economies. The major research interests of Olav Jull Sørensen are the internationalization process of companies, the global industrial dynamics, and the global value chain and government-business relations. He is presently involved in a project on the globalization of R&D related to China and the global value chain of agriculture related to Africa.