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The effects of social networking and collaborative gaming on the sustainability of virtual world-based online games

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Abstract

The success of online games such as "Second Life" and "World of Warcraft" heralds the expansion of cyberspace into the three-dimensional world, so-called virtual worlds and also reveals the emergence of economic systems embedded in them. This new economy, like its counterpart in the real world, has created exchanges of virtual goods, its own currencies that facilitate such trading, and wealth stocks of virtual goods. This new world economy does not exist in isolation. Residents in virtual worlds trade their virtual properties for real money. This real-for-virtual-money trading has become a multi-billion-dollar business. In this study, I analyze the economic impacts of the trading of virtual properties and strategies of the virtual economy operators with a stylish two-period game theoretic model. Unlike typical microeconomic modeling, prosumers in virtual world endogenously switch between seller and buyer roles. I find that real-money trading benefits game operators, and there exists an optimal amount in the supply of virtual properties for operators. I also find that the income disparity in the real world can be reduced when real-money trading is allowed. An empirical analysis with data from popular virtual worlds also confirms our findings. Moreover, I find a positive relationship between playtime and the market prices of virtual properties. Our findings, from both the analytical and empirical analysis, strongly imply the importance of the embedded economic systems in virtual world operation

Keywords: virtual worlds, social interactions, sustainability, mediating

1. Introduction

A virtual world, a computer-based simulated 3D graphical environment, is one of the most prominent business feature in the information and communication technology industry. Recent advances in computer graphics helped creat the three-dimensional virtual environments which make virtual worlds look more realistic. This innovation extended the use of virtual worlds to diverse areas such as commercial gaming, community building, or education. Among them online games are the most famous and commonly used business model in the virtual world industry due to their high profitability and immersive content delivery.

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The global online game market was estimated to grow $13 billion in 2011 (Carless, 2006). From the perspective of the entertainment industry, this size is similar to motion-picture revenues (Messinger et. al., 2009). Online games using virtual worlds also have a large number of subscribers. World of Warcraft, one of the world's most popular online games based on virtual world characteristics, had about 11 million users in 2011(Graham and Gosling, 2012). In terms of active users, world-famous online virtual world games such as "World of Warcraft" and "The Elder Scrolls Online" have more than millions of active users every hour.

One of the main features of virtual world-based online games are interactions among a large number of subscribers. Except for a few of them, most online games do not charge a subscription fee and generate revenue through the advertisements or sales of in-game items, which is generally called *Freemium* or *Free-to-Play* model in e-business. For that reason, the profit structure of virtual world-based online games is highly dependent on how long people stay active in their game worlds. Especially, virtual worlds consist of synchronous and persistent network of people. In other words, virtual worlds must continue to exist whether users are logged in or not. For this reason, the sustainable profit models of virtual world-based online games are influenced by inducing constant interaction between users who are persistently staying in the virtual world (Day, 2001).

Considering the importance of user interactions and sustainability of virtual world-based online games, this paper focuses on identifying the impact of user interaction on the sustainability of online games. To address this issue, my research adopts a resource-based model of social structure and empirically investigates how user interactions create benefit in virtual world-based online games and affect their sustainability. A resource-based model of social structure developed by Butler (2001), has been used in many studies related to the sustainability of online social networks, but there have been few studies on the virtual world business using this framework. I expect that my research shall be the first to adopt this model into the context of virtual world-based online games.

In order to apply the characteristics of the virtual world to the model, this study established the model by dividing the interaction between users into two types – social networking activity and collaborative gaming. Similar with typical business using social network characteristics, virtual world-based online games also provide general tools for social networking activities such as peer-to-peer communications and group creation among users (Riegle and Matejka, 2006). With the network of a large number of users and tools for supporting user communications, virtual world-based online games can be used as social media such as Facebook and Instagram. Therefore, general social networking activities can also be an important part of user interactions in virtual world-based online games.

Another important type of user interaction in online games are collaborative gaming activities. Most of contents in virtual world-based online games consist mainly of a character progression system. A character progression system is a common feature which motivates users' gameplay and keeps them in the game-world. This system is represented by 'level' and 'experience points' in games (Oliver, 2002). Players usually earn some experience points through some challenges made by game designer –hunting monsters or completing quests. The earned points are used to reach characters' levels. The level corresponds to a rating of character's power or skill (Mulligan and Patrovsky, 2003). For example, a character with higher level hunts monsters more efficiently in the game-world. Virtual world-based online games generally have a peak in character progression, and the primary goal of players is to reach this peak trough playing the game. Regarding with the progression system, collaborative gaming affects players' activities to reach the maximum level in the game. In terms of contents design, virtual world-based online games require players to collaborate with each other during their gameplay (Brown and Bell, 2004). Game players usually make a group of two to five members – a group called 'party'– and hunt monsters and achieve quests together. Collaborative gaming definitively can benefit players because it increases efficiency in progressing characters.

Considering the effect of the two different types of user interactions on sustainability of virtual world-based online games, the main goal of this paper is to find significant effect of the two types of user interaction – social networking and collaborative gaming activities – on sustainability of virtual world-based online games. I also focus on the relationship between collaborative gaming and social networking activity in the benefit creation process in virtual world-based online games. Previous research on social interactions in online games was mainly focused on patterns of interactions (Brown and Bell 2004, Chen et. al., 2007). However, most of them were not concerned with the dynamics between the two types of interactions or their impact on sustainability of online games or virtual worlds. Several studies agreed that collaborative play is beneficial to users and increases the speed of progression in online games. From the perspective of social networking, previous studies usually focused on emotional behavior such as patterns of chatting messages. However, most of the research studied these two effects separately. Therefore, this research tries to observe the dynamics between collaborative play and social networking in online games, and find the impact of these two interactions on online games' sustainability. Based on the argument that character progression is the first priority of game players, I hypothesize that collaborative gaming increases social networking activity in online games. In the analysis of this paper, I use data generated from an online game and empirically test the mediation effects of collaborative gaming and social networking activity on sustainability of online games.

The rest of this research consists of four sections. First of all, I organize previous studies to construct the research framework. The next section tries to set the research framework and model for the analysis. The third section shows the results of the analysis and suggest several implications from this analysis. The final section summarizes results and mentions several limitations of the research and suggests further research.

2. Related works

This section is organized in two parts. I first review previous studies on the sustainability of social network, and find the theoretical background of my research framework. I also review previous studies related to virtual worlds and online games and identify the difference between this research and previous studies.

2.1 Research on the sustainability of online social network

There are several models that address the sustainability of online social network. Butler (2001) applied resource-based theory and explained how continuous involvement of users of online social network affects membership retention in online social network. There are several theories that explained how social capitals (Simpson, 2005) or social interactions (Butler, 2001; Cheung and Lee, 2009) affect the sustainability of online communities. Butler et al. (2014) built "attrition-selection-attrition" theory and explained online community development. This theory includes participation costs, topic consistency cues and their impacts on community size and resilience. From a psychological perspective, Chang et al. (2015) used technology acceptance model to explain the effect of conformity tendency and perceived playfulness on the continuance of using social network sites. Mamonov et al. (2016) developed the sense of community theory to exlain that sense of community has a strong effect on information consumption and contribution which in result increases the sustainability of online social network sites. Kim and Mrotek (2016) emphasized resource richness and design features of online community and explained the sustainability of online health communities. Gupta (2019) determined the perceived importance of the stage of interaction in terms of social sustainability to explain sustainable design of online communication platforms. The elements emphasized by previous studies on the sustainability of online communities may differ, but most of them have something in common: user interaction.

Therefore, my research also focuses on the relationship between user interactions and sustainability of virtual world-based online games. However, I also try to identify the unique characteristics of interactions in virtual world-base online games and to differentiate my research from the previous works.

2.2 Research on virtual worlds and online games

This section explains brief outline of previous studies related to virtual worlds and online games. Most of previous studies had been mainly focused on users' online gaming behavior and user interactions in online games.

Players' motivation in virtual worlds is an important factor to exlain why users play online games. This issue has been usually related to the features of online games. Based on Bartle's (2004) classification of online game player's motivations, purposes of playing online games can be broken down into 4 different types: socialization, player-killing, exploration of gaming worlds, and achieving goals in gaming worlds. Yee (2006a) reorganized Bartle's classification and suggested 3 types of motivations – socialization, exploration and immersion. Choi and Kim (2004) adopted the flow theory and explained that users continue to play online games if they have optimal playing experiences. They mentioned that the optimal experiences can be obtained by appropriate goals and effective personal interactions. Competition between users also has a positive effect on users' flow and enjoyment in the game (Weibel et al., 2008).

The basic principle of online game design is how to make game players experience fun and enjoyment in the game (Koster, 2013). Previous research has categorized several features that affect user experience in an online game. In a broad perspective, Dickey (2007) selected design of avatars and narrative environment as the two primary features in an online game. Lo and Wen (2010) categorized the design features (of MMORPGs) into nine factors: avatars, environmental setting, sound/logic effects, user-task, game world rules, premium items, social community, user interface, and quality of services. As shown in the previous studies, most studies consistently show that avatar design, game environment, and social interactions are the major components of online game design.

The social relationship with other players is one of the crucial predictors of users' game participation and continuation of playing games. As a result, the interaction between users is an important factor in online game design (Salen and Zimmerman, 2004). Some exploratory studies highlight socialization, achievement, and competence in the process of adopting online games (Bartle, 2004; Yee, 2007). Social awareness increases players' intention to return to virtual worlds (Goel et al., 2011). Moon et al. (2013) showed that strong social ties increase players' loyalty (retention rate) to an online game. Shen et al. (2014) analyzed the patterns of social interactions in an online game and showed that game players tend to exploit existing relationships rather than develop new ones.

Some studies analyzed social relationship based on the relation type and/or its strength. Shen et al. (2014) showed that social ties between players with the same level of abilities are less likely to decay, which represents the theory of homophile. Goode et al. (2014) showed that gifting game items to other players strengthens the giver's social relationships. Lounis et al. (2014) showed that a player's experience of fun is positively affected if he/she can team up with other players pursuing the same goal.

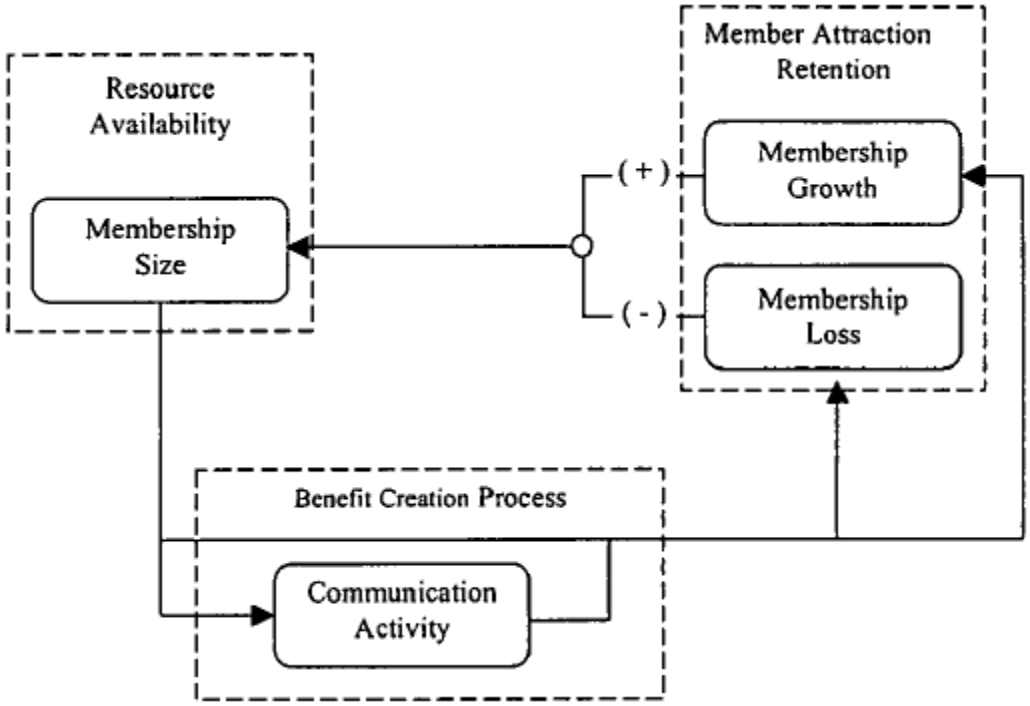
Although there is few research on online games' sustainability itself, most studies used a term 'fun' or 'enjoy' instead of sustainability and discussed how to increase fun in online games (Yee, 2006a). Most of these studies used flow model to describe factors which affect fun in online games (Voiskounsky et. al., 2004; Kim et. al., 2005; Rafiana et. al., 2005). Yee (2006b) defined motivations for playing in online games. In this research, he classified motivation in three categories –achievement, social, and immersion. Achievement is related to progress, power, or challenges, which might be affected by collaborative gaming. Social is related

to social networking activities, for example casual chat or making friends in online games. Immersion is related to finding new things in games. Based on these categories, I hypothesize that game players' motivations are affected by collaborative gaming and social networking activities.

3. Research model and data

3.1 Research model and data

Figure 1. A resource-based model of social structure



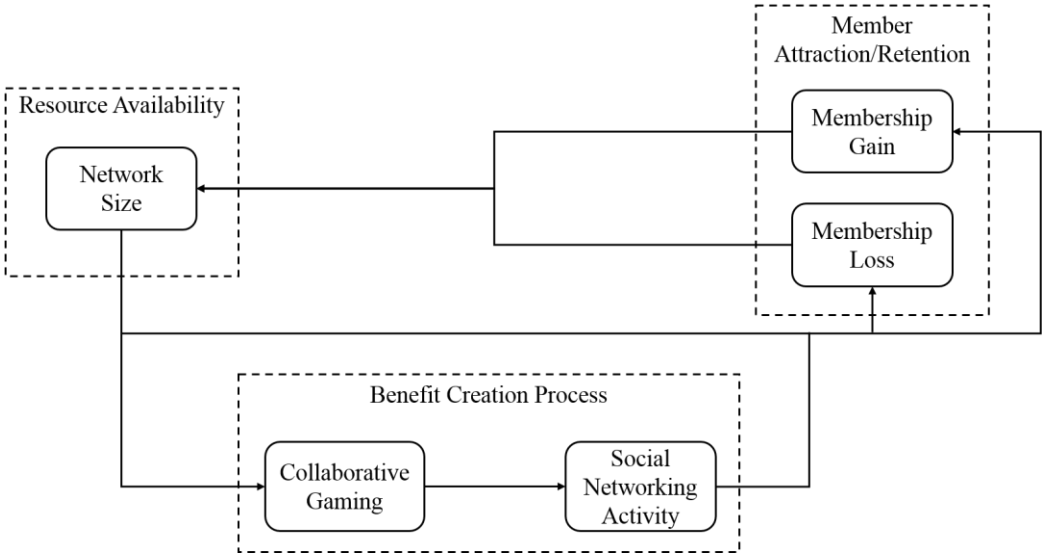
Source: Butler (2001)

The basis of this research framework is from a resource-based model of sustainable social structures (Butler, 2001), which is presented in Figure 1. This model explains development of social structure in terms of internal benefit creation process in an online community. Resource availability in this model is described as an input required to create benefit. The membership size is affected through the benefit creation process, and eventually the membership size determines sustainable social structure of online community. Resource availability is an underlying ability of social structure to provide valuable benefits to the affiliated members. The available resources in social structure include knowledge, time, money, or any other intangible or tangible assets in the network. Generally, those resources available in the network can be represented by the membership size of the community (Haveman, 1993). This means that the larger the network size is the more

resources can give benefits to members. Therefore, the membership size of the community can be used as a proxy for all the resources available in the network. Benefit creation process explains how the available resources create benefit in the network. Benefit in social structure is mostly created by interactions among members such as knowledge sharing (Adamic et. al., 2008) or communication (Koh et. al., 2007). The created benefit based on communication activity affects both membership gain and loss, which affects sustainability of the community. If membership gain is higher than loss, the social structure in this model is considered to be sustainable. Eventually, the membership size in the community – which represents resource availability – and the membership size reciprocally affect each other in the model.

After Butler (2001) suggested this model, many studies related to online social networks have adopted the resource-based model to explain sustainability of the networks. For example, Benbunan-Fich and Koufaris (2010) applied this model and modified the benefit creation process in the context of social bookmarking sites. Asvanund et al. (2004) used the resource-based model and examined network externalities in peer-to-peer music sharing networks. This model is also applied to various business models using online communities such as expertise-sharing networks (Tiwana and Bush, 2005) or even social networking services (Hu and Kettinger, 2008). Bock et al. (2015) interpreted benefit creation process as information sharing activity and showed that information sharing activity positively affects sustainability of online web communities. Shang (2019) game-theoretically modelled the benefit creation process in online health community and showed that users' continuing participation positively affects the sustainability of online health community.

Figure 2. Research framework for online game sustainability



The research model in this analysis extends the previous model to the area of online games which consist of virtual communities. Its research framework is shown in Figure 2. Similar to Butler (2001)'s original framework, I first assume that the number of users in online games – network size – is the available resource. The membership size is generally known as the major resource of providing benefits to members. In terms of interactions, the larger size generally gives more possible interactions based on Metcalfe's law (Metcalfe, 1995). The main focus in the benefit creation process is to identify how gaming and social activity interact

with each other, which are the main goal of playing online games. As a result, I assume the path between collaborative gaming and social networking activity. According to the nature of online game design, the primary goal of online games is to enjoy the contents provided by game designers. Especially, these contents are consumed according to the progress of players' game characters. Therefore, this analysis assumes that collaborative game play precedes social networking activity. This means that players in online games did not make friends before collaborating with each other. For that reason, I first hypothesize the relationship between collaborative gaming and social networking activity, and the effect of membership size on these two types of social interactions.

Hypothesis 1. The membership size of online games positively affects collaborative gaming.

Hypothesis 2. The membership size of online games positively affects social networking activity.

Hypothesis 3. The increase in collaborative gaming leads to more social networking activity.

The gain and loss in online community determine its sustainability. Likewise, the model in this study assumes membership gain and loss are the measures of sustainability in online games. In terms of membership gain, collaborative gaming and social networking activity make online games more viable and attract potential players to online games. This benefit is similar to that of the typical online community. The main focus of this analysis is on the effect of membership loss. The nature of online games is that a player's primary goal is vanished once the progression reaches its maximum. In that case, players usually have no options left but to give up the game. Therefore, this analysis tries to find out how social interactions reduce membership loss in online games. As assumed in the framework, if collaborative gaming leads to social networking activity, the existing members increase their relationships with other members and stay in online games without consumption of game contents. Therefore, this model hypothesizes the relationships between social interactions and membership gain and loss.

Hypothesis 4-a. The increase in collaborative gaming leads to higher membership gain in online games.

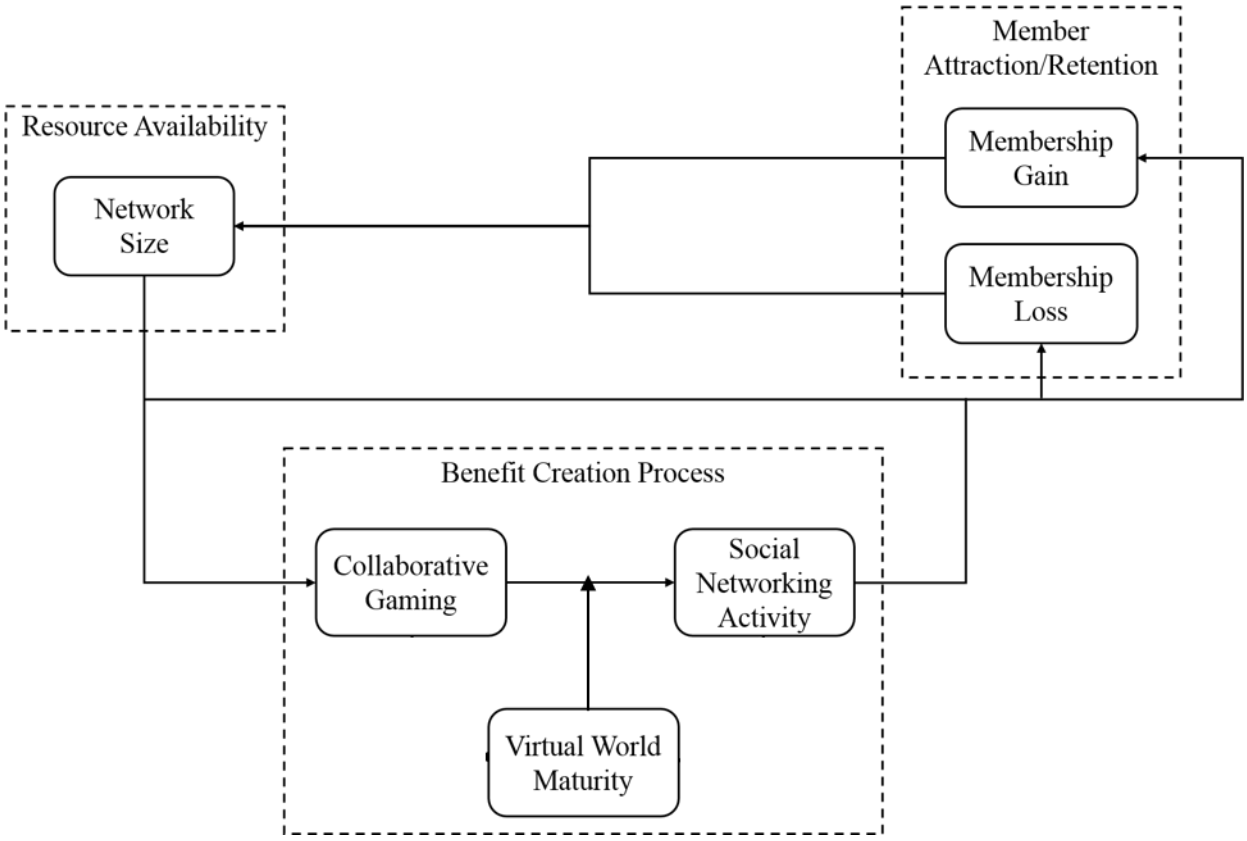
Hypothesis 4-b. The increase in collaborative gaming reduces membership loss in online games.

Hypothesis 5-a. The increase in social networking activity leads to higher membership gain in online games.

Hypothesis 5-b. The increase in social networking activity reduces membership loss in online games.

I additionally consider the moderation effect of virtual world maturity on the benefit creation process. The virtual world maturity is an indicator of how old the virtual world actually is. As the virtual world maturity increases, it is more likely that the average gaming experience also increases. For that reason, I think that virtual world maturity might affect the process between collaborative gaming and social network activity in the online game community. As a result, I focus on how the effect of collaborative gaming on social networking activity can be different according to the virtual world maturity. For this purpose, I use the virtual world maturity as a moderator between collaborative gaming and social network activity in the revised framework shown in Figure 3.

Figure 3. Research framework for online game sustainability with maturity



3.2 Data and measures

For the empirical analysis of the research model, I collected the data from an online game, developed by a Korean game company. This company is one of the top developers/distributors in the Korean market. This company was found in early 1990s, and has provided dozens of online games in Korea. In 2010, the company recorded a revenue of $ 0.9 billion. The data of this empirical analysis is collected from the one of the most popular games from this company. This game was first introduced in February 2010 and has been on the market until January 2017, which means that the total service period is almost seven years. During the total service period of this game, I collected the data from February 23, 2010 to August 23, 2010 on a weekly basis. This means that the total number of observations of the data is 26 weeks.

One of the main unique characteristics of this particular online game is that it provides multiple virtual worlds within the same environment in one game, which is called a “server.” Due to the limitations of the network capacity, generally online games cannot basket all players in one platform. For that reason, the game developer creates several different servers to limit the number of total users in each server. However, each

server has the same design, character progression system, and graphical representation. The game for the empirical analysis provided 5 different servers, and 26 weeks of observations in each server (total 130 observations). Each server usually contained about tens of thousands of players.

For the measurement, I define the size, collaborative gaming, social networking activity, maturity, and membership gain and loss in the data. The membership size ($Size_{it}$) is the number of registered users in a server i at the beginning of the week t. Collaborative gaming (CP_{it}) is defined as the number of hunted monsters by group play. A gaming activity in a character progression system is usually defined as accomplishing mission given by the game developer. In this game, hunting monsters designed by the game developer is the essential part of progression system. When a player kills a monster, he/she receives a certain amount of experience points. This experience points are accumulated and lead to the increase in the level of characters. Therefore, this analysis defines the amount of collaborative play in a server as the number of monsters hunted by a group play. The social networking activity in the game is similar with social networking in typical social media platform, for example sending messages or chatting with the members. For the social networking activity (SN_{it}), the data in this analysis is able to capture the total amount of time spent on online chatting among players. The data records the timestamp at which a user starts forming a group with other users and the timestamp at which he/she ends group formation. At the time of ending group formation, the data records amount of time for which the user played the game and the conversations with the group members while the group was still active. As a result, I extracted the time spent for social networking activity from the data. The membership gain ($Gain_{it}$) and loss ($Loss_{it}$) is the number of net increase and decrease users at the end of the week t. The detailed operational definition of each variable is described in Table 1. I also define the maturity which means the average level of members on the server. A high average level of users on the server means that users have played games for a longer period of time. This means that game content has been consumed frequently, and that the maturity of the server is high.

Table 1. Measurements in the analysis

Name	Label	Definition
Membership Size	$Size_{it}$	The number of users in server *i* at the beginning of week *t*
Collaborative gaming	CP_{it}	The total amount of monsters hunted by party play in server *i* during week *t*
Social Networking Activity	SN_{it}	The amount of time (hour) spent on the conversation between the members on server *i* during week *t*
Maturity	M_{it}	The normalized average level of members in server *i* at the beginning of week *t*
Membership Gain	$Gain_{it}$	The total number of users added to server *i* during week *t*
Membership Loss	$Loss_{it}$	The total number of users who left server *i* during week *t*

For the variables in the empirical analysis, I extracted the data from each player's log data of one MMORPG which consist of five identical servers. The descriptive statistics of each server is described in Table 2. As in other networked internet services, online games record every player's activity in their log files. These files are recorded whenever players take a certain action, such as purchasing game items, hunting monsters, or transporting somewhere. This analysis was tracking this database from February to August,

2010 and extracted the data for regression. There existed over 800,000 different accounts in the entire game, but most of them are just temporary visitors. According to the data, over 80% of accounts only stayed in the game for just a couple of minutes. Therefore, the analysis excluded this type of accounts, and consequenly, there were about 100,000 players left in the entire servers.

Table 2. Descriptive statistics of game servers

	Server 1	Server 2	Server 3	Server 4	Server 5
Membership Size	26,284	24,158	25,286	24,563	23,599
Membership Gain	5,898	2,768	2,184	5,619	1,782
Membership Loss	7,513	4,032	4,335	7,079	3,779
Collaborative Gaming	299,651	291,164	299,988	292,869	289,909
Social Networking	4,439	4,115	4,473	3,950	3,979
Avg. Level	11.75	12.77	12.54	12.32	12.94
Var. Level	11.47	11.31	11.23	11.53	11.34

Although each server provides the identical game environment, each server shows different statistics. As mentioned earlier, all five servers have the identical game designs except for their demographics. Each server has about 25,000 members in . Server 1 has the largest membership size and Server 5 has the smallest one. Generally, the statistics shows that high membership size includes both high membership gain as well as high membership loss. This is similar picture to what I hypothesized earlier. However, Server 4 shows relatively high membership gain and loss due to the small membership size. Based on this statistic, a player spends average 52.0 minutes per week on this online game. In terms of social interactions, each player hunts 11.89 monsters by group play in a week, and spends 10.15 minutes for social networking activity. These data suggests that social networking activity occupies about 20% of play time. In terms of social networking activity, users in Server 1 and 4 spend more time than users in the other servers. Maturity is defined as average level divided by variation of level. A high average level implies that players have been staying in the game for a longer time, while a high variation of level means there is a high influx of new members. Therefore, the defined maturity indirectly shows the sustainability of the server.

4. Analysis and results

4.1 Regression models

For the analysis, I use time-series cross-sectional random effect model. To test the effect of benefit creation process in the research framework, I need to treat the benefit creation process as a mediator between membership size and membership gain and loss. To test the mediation effects of benefit creation process between membership size and membership gain and loss, I set up regression models from (1) to (6). This approach of setting 6 different regression models is based on the method of testing the mediation effect by Baron and Kenny (1986). Since the designs of five servers are identical, it can be considered that there is no need to worry about the possible external factors related to server characteristics in the analysis. Therefore, all the regression models use only the variables described in the framework. The first two regression models test the relationship between the size and membership gain (model (1)) and between the size and membership loss (model (2)). These models identify the effect of membership size to membership gain and loss without

the mediation effect. The reason for using a log term in every variable is to minimize the problem of non-normality of the data.

$$\ln(Gain_{it}) = C_1 + \beta_1 \ln(Size_{it}) + e_{it} \quad (1)$$

$$\ln(Loss_{it}) = C_2 + \gamma_1 \ln(Size_{it}) + e_{it} \quad (2)$$

The next two regression models focus on mediators in the research framework. Since there are two mediators in the framework, model (3) tests the relationship between the membership size and the first mediator, collaborative gaming. Model (4) is for testing the relationship between the size and the first and the second mediator, social networking activity.

$$\ln(CP_{it}) = C_3 + \alpha_1 \ln(Size_{it}) + e_{it} \quad (3)$$

$$\ln(SN_t) = C_4 + \alpha_2 \ln(Size_{it}) + \alpha_3 \ln(CP_{it}) + e_{it} \quad (4)$$

Finally, the last two regression models (model (5) and (6)) are for testing the relationship between membership gain and loss, and the rest of factors. The first one of the last two uses membership gain as the dependent variable and membership size, collaborative gaming, and social networking activity as independent variables. The last regression model uses membership loss as a dependent variable and uses the same independent variables as the regression model (5).

$$\ln(Gain_{it}) = C_5 + \beta_2 \ln(Size_{it}) + \beta_3 \ln(CP_{it}) + \beta_4 \ln(SN_{it}) + e_{it} \quad (5)$$

$$\ln(Loss_{it}) = C_5 + \beta_2 \ln(Size_{it}) + \beta_3 \ln(CP_{it}) + \beta_4 \ln(SN_{it}) + e_{it} \quad (6)$$

First of all, through the estimation of models, I examine whether there exist mediation effects. For example, comparing the coefficients of membership size in Model (1) and (5) leads to the existence of the mediation effects in the research framework. If the coefficient in Model (1) is higher than the one in Model (5), I can conclude that there exists the mediation effect between membership size and gain. In the same way, comparing the coefficients of membership size in Model (2) and (6) also leads to the existence of the mediation effect between membership size and loss. Model (3) and (4) are to confirm the significance of the path between membership size and membership gain and loss.

Before the estimation, I confirm that there exists causality between collaborative gaming and social networking activity by testing Granger Causality test. Hausman test is also confirmed that this data is suitable for two-way random effect models. For the estimation, I use EVIEWS 6.0.

4.2 Regression results

Table 3 shows the result of the analysis without moderator variable – virtual world maturity (*M*it). All variables except the intercept variable are statistically significant. Comparing the regression results of Model (1) and (5), the coefficient of membership size on membership gain decreases by 0.47 after including

mediator variables – collaborative gaming and social network activity. This implies that both collaborative gaming and social network activity affect the link between membership size and membership gain. Comparing the coefficients of membership size on membership loss in Model (2) and (6), the results show that the absolute value of coefficient in Model (2) is higher than the one in Model (6). This shows that there exits the mediation effect of collaborative gaming and social network activity on the relationship between membership size and loss.

Table 3. The estimation results

	Mediation Effects		Member Attraction		Member Retention	
	Model (3)	Model (4)	Model (1)	Model (5)	Model (2)	Model (6)
	$\log(CP_{it})$	$\log(SN_{it})$	$\log(Gain_{it})$	$\log(Gain_{it})$	$\log(Loss_{it})$	$\log(Loss_{it})$
Intercept	10.13***	4.39***	-28.8**	-20.1	42.34**	31.67
$\log(Size_{it})$	0.24***	0.46***	3.53***	3.06**	-4.16**	-3.42*
$\log(CP_{it})$		0.59***		0.46***		-0.27*
$\log(SN_{it})$				0.33**		-0.74*
Observations	130	130	130	130	130	130
Adjusted R^2	0.25	0.32	0.07	0.22	0.10	0.27

Along with the mediation effects, the results also show the path between these two mediators. According to the results, the amount of collaborative gaming is positively related to social networking activity. The regression results for Model (3) and (4) show that the membership size positively affects both collaborative gaming and social networking activity. Coefficient of collaborative gaming on social networking activity in Model (4) also shows a positive and significant value. This means that the benefit creation process between membership size and membership gain/loss in the research framework is statistically significant, considering that all the paths in the process have proportional relationships. This implies that collaborative gaming play among users in virtual communities can be transformed into users' social networking activities. Generally, online game designers give players incentive to participate in collaborative play by increasing the efficiency of collaborative gaming. However, in terms of revenue creation, this might harm profit of online games, because it decreases time to play game contents or users' motivation for purchasing game items which can be purchased by real money (not in-game money). However, this result explains why game designers let users participate in collaborative gaming, because it eventually transforms to social networking activity. This implies that players in online games make friends by hunting monsters together. This also gives evidence that players are still in the game after reaching the maximum level in the game. If players become more active in social networking activities as they participate in more collaborative play, the motivation of staying in the game even after they consume all the game contents also increases. Therefore, it is strategically important to motivate players to participate in collaboration and make friends in online game before they reach the maximum level.

Table 4 shows the results of the estimation after including the moderator variable between the two mediators. I hypothesize that the effect of collaborative play on social networking grows as the maturity of online games increases. The maturity in this model implies the age of online games. A higher maturity means that there are less new contents in the game. Therefore, the effect can be different when the maturity is under consideration. In the analysis, the maturity of an online game is measured by users' average level in each server. The interaction term of the maturity of the online game (M_{it}) and the amount of collaborative gaming

(CP_{it}) is additionally included in the regression model (4), (5), and (6). As shown in Table 4, the interaction term in the regression models is statistically significant. In the regression model for mediation effects, the effect of collaborative gaming on social networking activity increases as the maturity of the online game increases. In the model for member attraction (retention), the effect of collaborative gaming on membership gain (loss) increases (decreases) as the maturity of the online game increases. This implies that the social networking activity affected by collaborative play becomes more important as less contents in the game become available. This provides a plausible explanation for the reason why a great number of experienced players are still active in the game even after reaching the maximum level.

Table 4. The estimation results considering maturity in the model

	Mediation Effects		Member Attraction		Member Retention	
	Model (3)	Model (4)	Model (1)	Model (5)	Model (2)	Model (6)
	$\log(CP_{it})$	$\log(SN_{it})$	$\log(Gain_{it})$	$\log(Gain_{it})$	$\log(Loss_{it})$	$\log(Loss_{it})$
Intercept	7.10***	2.75**	-28.8**	-13.23	42.34**	35.23
$\log(Size_{it})$	0.69***	0.78***	3.53***	2.24*	-4.16**	-3.16**
$\log(CP_{it})$		0.47***		0.24*		-0.29*
$\log(SN_{it})$				0.33**		-0.12*
$\log(M_{it})\times \log(CP_{it})$		0.03***		0.82***		-0.40**
Observations	130	130	130	130	130	130
Adjusted R^2	0.34	0.41	0.07	0.42	0.10	0.29

When compared with the results by Butler (2001), the finding that the membership retention decreases as the social interactions in the game increase is very interesting. Generally, previous research showed that both attraction and retention increase as the membership size increases. However, the results in this paper show that membership retention decreases by increased social interactions. This implies that social interactions are very important for the management of existing users. From the managerial perspective, operators try to build friendship among players and give other benefits after all contents in the game are consumed.

4.3 Business implications

According to the regression results in the previous section, several implications for facilitating virtual communities can be derived. First of all, the regression results show that both collaborative gaming and social networking activity, which are the essential parts of user interactions in the virtual world, help to maintain the size of the virtual gaming world. This means that encouraging users to play game contents with other users and strengthen their social network increases membership gain and decreases membership loss in the community. This indicator of virtual world sustainability is directly related to the revenue of virtual worlds. Therefore, the regression results imply that encouraging user interactions in virtual worlds increases the revenue. From the business perspective, it is critical for game developers how to boost user interactions in the virtually designed worlds. For this issue, many online games design various features of collaborative or group game play in their services. These strategies can be explained by the regression results from the previous section.

Especially, the results also explain how collaborative gaming can facilitate social networking activity in the game. The regression results regarding the mediation effect shows that social networking activities can

be affected by collaborative gaming. This suggests that connecting anonymous users through collaborative gaming positively affect the sustainability of virtual worlds. These results imply that virtual world developers should help users who are playing alone to find adequate partners for collaborative play. Especially, it is important that the effect of collaborative gaming on social networking activity becomes stronger in the virtual worlds with higher maturity. Considering that virtual world developers are not able to continuously create gaming contents, facilitating social networking activities encouraged by collaborative gaming helps users keep staying in the world even after there is not much of the game content left. This explains why many virtual world designers include gaming contents and social networking tools in their services.

In terms of revenue creation strategy, our results suggest facilitating user interactions can be a new revenue source of virtual worlds instead of adopting micro-transaction strategy. Usually, most of virtual worlds use virtual goods sales as a main revenue model. However, the purchase of virtual goods with real money has been very controversial in Korea because of the gambling issues. Under these circumstances, maintaining the network size of the virtual world by facilitating user interactions can be an alternative solution for increasing revenue.

5. Conclusion

This research basically tries to find how social interactions affect sustainability of online games. For this issue, this paper adresses the two types of social interactions – collaborative gaming and social networking activity – and analyzes the mechanism of social interactions in online games and estimates the relationship between social interactions and sustainability of online games. The model here is based on a resource-based model of social structure. I define the benefit creation process in online games and test the mediator effect of collaborative play and social networking activity.

The major finding of this model is that social interactions in online games increases membership gain and reduces membership loss. Moreover, the results show that collaborative gaming precedes social networking activity. This explains why online game designers try to encourage collaboration among players. By increasing efficiency of gaming, game designers facilitate collaboration. This might reduce gaming life cycle, but instead players can build friendship through collaborative play. This will eventually make players stay in the game even after all of the contents are consumed.

One of major contributions of this research is the analysis of the mechanism of social interactions in online games. Previous studies mostly focused on the patterns of social interactions and overlooked their impact on sustainability of online games. Moreover, previous studies considered collaborative play and social networking separately, but this research analyzes the dynamics between the two types of social interactions. From the perspective of game design, gaming is the main purpose why people participate in the game-world. Social networking activity is not the main purpose of game players, but it makes players stay longer in the game. Our analysis mainly shows that collaborative gaming is a kind of a decoy which makes players build friendships in a game world. Obviously, a collaborative gaming decreases the time spent on gaming, but it also creates another purpose of staying – social networking. This is extremely important for players who have already reached the maximum level or character progression in the game. These players literally have no game content for play, but they have a reason to stay in the game – friends. Most online games, which have been operating for more than two or three years only gain a small number of new subscribers on a regular basis. However, because of social networking activity, these games can survive even with the tiny amount of new subscriptions and lack of game contents.

For further research, I plan to analyze an individual level of dynamics between collaborative gaming and social networking activity. Though the result of this paper shows the sustainability in macro-level, it is also important find individual choices of gaming play in terms of social interactions. Therefore, the next step is to find how individual establish collaborations and when they decide to quit online games. For this research, I am collecting individual network data of online games and prepare for social network analysis of online games.

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