An Exploration of the Relationship between Boundary Spanning and Organizational Performance

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2011

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A thesis

submitted to the School of Technology Management

and the Graduate School of UNIST

in partial fulfillment of the

requirements for the degree of

Master of Technology Management

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07.18. 2011

Approved by

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07.18. 2011

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ABSTRACT

In this paper, we present a study that examines how individuals who take the role of boundary spanner affect organizational innovativeness inside the team. Recently, there has been growing attention from burgeoning interests in open innovation and interdisciplinary R&D on boundary spanning and its impact on innovative culture or the capability of organizations. Boundary spanning is concerned with detecting internal or external information and then creating networks that connect between the environment and the organization. Such informational boundary spanners successfully translate acquired information and knowledge across communication boundaries. Therefore, they are considered key players of open innovation in many cases. To fill this role, they are usually aware of contextual conditions on both sides of the boundary and able to control the situation inside the firm.

For organizational innovativeness, we consider ambidexterity and absorptive capacity as theoretical foundations of our research. Ambidexterity refers to an organizational characteristic that pursues the balance between exploration of new knowledge and exploitation of existing knowledge. It is not counterintuitive that boundary spanning is associated with the activities of exploration as they are intended for tapping into diverse expertise and insights.

Our research model posits associations among vertical and horizontal boundary spanning within an organization, organizational combinative capabilities, and ambidexterity. We expect that this study can provide a better understanding on the dynamic mechanism of boundary spanning and the role of innovation leaders and also an insight into the questions: what is the bottleneck in the innovation process of our company? And how can we overcome the obstacles? Specifically, we will examine the relation among (1) Boundary spanning, (2) Diversity inside the unit, (3) Empowerment, (4) Ambidexterity, (5) Organizational performance. Thus, the main goal of this research is to examine whether the organizational performance varies as a results of boundary spanning roles which could be influenced by the diversity of the unit and empowerment.

The main method of our study was survey of professionals working in R&D departments. After reviewing relevant literature and selecting a pool of items, we conducted a survey. The questionnaire distributed randomly, and we mainly used survey instruments adopted from prior works. All components inside construct were measured with multi-item scales. Boundary spanners, ambidexterity, power relation, diversity, and performance were the latent variables. To remove the common method bias, we used Modern MTMM technique and Harman's single-factor test. Also we examined differences between non-response biases. After checking the construct and content validity, and the reliability of the instruments, we employed PLS (partial least squares regression) analysis to find out the relations among variables.

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I. INTRODUCTION

Recently, there has been growing attention from burgeoning interests in open innovation and interdisciplinary R&D on boundary spanning and its impact on innovative culture or the capability of organizations. To cope with uncertainty in their business environment, organizations must deal with new knowledge and understand internal dynamics so that they can achieve technological innovation. To have a broad knowledge base, an organization must embrace advanced knowledge through both internal and external channels. In this sense, boundary spanning has emerged as a key part that encourages organizational innovativeness. Several studies have been examining this topic to reveal the relationship between boundary spanning roles and organization performance. Yet, even though researchers suggest that higher level of boundary spanning roles are associated with higher level of organizational performance (Ancona, 1990, Choi, 2002), it is still unclear to practitioners which inner mechanism of the boundary spanning roles translates into organizational performance. Many companies observed that substantial levels of boundary spanning do not always lead to high organizational performance. This raises another question; what conditions or contingency factors affect the successful implementation of boundary spanning roles that can contribute to organizational performance? We expect that this study can provide a better understanding on the dynamic mechanism of boundary spanning roles and the role of innovation leaders and also an insight into the questions: what is the bottleneck in the innovation process of our company? And how can we overcome the obstacles?

This paper is structured as follows. First, we present a relevant literature review that lays out the theoretical foundations for our study. Second, our research model is explained, along with a set of hypotheses to test associations among constructs such as boundary spanning roles, knowledge exploration, knowledge exploitation, organizational ambidexterity, team empowerment, diversity of unit, and organizational performance. Third, our research method is suggested with an emphasis on instrument validation and data collection through the PLS method. Additionally, we used SPSS 18.0 to check non-response bias, and common method bias. Finally, the implication of this research and a future research plan is discussed.

II. PRIOR WORK

2.1 Boundary spanning roles

Boundary spanning is concerned with detecting internal or external information, and then creating networks that connect between the external environment and the internal organization (Tushman and Scanlan, 1981). An organization which stays in a certain environment is dependent on well-established rules, so they tend to demand minimal boundary spanning roles. On the other hand, these boundary spanning roles are especially needed when an organization is increasingly identifying environment uncertainty. In uncertain environments, organizations take great pains to reduce perceived environmental uncertainty (Duncan, 1971). That is the reason why organizations adopt boundary spanning roles. Also innovative organizations should be continuously connected with outside communication to bring up new information, which is advanced and innovative.

Nominated skilled individuals who successfully translate acquired information and knowledge across organizational boundaries are considered key players of open innovation in many cases. Cross (2004) suggested that boundary spanners are the vital individuals who work as mediators and make circumstance easier for sharing expertise among different locations, hierarchies, or purposes. Boundary spanning roles give importance, not only to sharing and translating external information within an organization, but also transmitting internal information to external organizations (Aldrich and Herker, 1977, Tushman, 1977). Organ (1971) said that the boundary spanners are the "linking pin" which stay at the boundary between the organization and the external environment. Furthermore, an organization's ability to absorb new information is affected by its individual members, and we think those individual member are boundary spanners (Cohen and Levinthal, 1990). These individual members maintain their position in the interface of both the firm and the external environment so that they can monitor both side and provide useful information to the organization. For this, they must be aware of two part's processes to capture values from both sides of the boundary and control the situation inside the firm. Also Roger mentioned 'opinion leader' in his book 'diffusion of innovation'. Boundary spanners are equivalent to opinion leaders, and he explained that these people are greatly exposed to external media than their followers. Those people are considered as an interpersonal channel and they have some capabilities such as accessibility, socioeconomic status and innovativeness.

Normally, the most proficient individuals in their unit can be authorized to do this job. Ancona (1990) emphasized the importance of the group leader's skills because how group members approach their environment is affected by the leader. So, boundary spanners are the representatives who are technically competent and have the skill of communication with external areas (Tushman and Scanlan, 1981). They have several abilities such as communication skills, open mindedness, responsibility..

Adams (1976) addressed five types of boundary spanning activities as: filtering, transacting, buffering, representing, and protecting.

In addition, it is better to have several nominated individuals rather than just one. When boundary-spanning roles are allocated to several people, it would bring better results than when one is charged with this role. There are studies that prove boundary spanning roles can incite role overload (Aldrich and Herker, 1977, Marrone et al., 2007). Individual-level boundary spanning brings a lot of pressure and demands to the one who charged. The only person in charge of the boundary spanning role should put in substantial effort and time compared with other members inside the unit (Beehr et al., 1976, Marrone et al., 2007) . Consequently, individuals shirk the responsibilities of this position, whereas a team assists each other to cut pressure down. Also when a team has connections with boundary spanning, there are more chances to achieve the team's goal (Ancona and Caldwell, 1990). So here, we decided to focus not on the individual level, but on the team.

2.2 Ambidexterity

Ambidexterity is positioned between the boundary spanning and organizational performance and it plays the role of a mediator in our model. Several studies suggest that the creation of new knowledge, and the reinforcement of existing knowledge should be combined with ambidexterity (Ancona and Caldwell, 1990). Ambidexterity provides an analysis framework that can take into account the dual structure of organizational innovation: knowledge exploration and knowledge exploitation (Duncan, 1971).

Firms tend to get competitive advantages through establishing and shielding expertise of existing knowledge(March et al., 1958). For instance, Podolny (1996) conducted a survey in ten largest Japanese Semiconductor companies. He found out that most of the companies focused on those activities associated with prior activities. This phenomenon is caused by firm's preference of path dependence, which is equivalent to system capabilities. Jansen et.al (2005) analyzed organizational antecedents as common features of combinative capabilities. System capability is one of the combinative capabilities that affect a firm's knowledge absorption. It provides a memory for handling routine situations (Van Den Bosch et al., 1999)including formalization and routinizaton. Formalization, when rules, procedures, instructions, and communications are formalized or written down (Khandwalla, 1977), can be an obstacle when it is related with acquisition and assimilation of new external knowledge. At the same time, formalization facilitates the retrieval of knowledge that has already been internalized (Lyles and Schwenk, 1992), so that it brings opportunities for transformation and exploitation of knowledge. Routinization blocks the insight into external sources by reducing exposure to other units. On the other hand, a repetitious process can help employees to

perform efficiently and increase their understanding of task relationships.

As researchers focus on organizational exploitation, it is not surprising that they gradually realized that firms can't keep up their state of holding just exploitation. Researchers started reporting that exploration is also positively related to organizational performance (Raisch and Hotz, 2010). They started to consider creating new markets and developing new channels of distribution (Abernathy Kim and William, 1985). To meet the needs of emerging customers, they search for the discovery of new approaches to technology (McGrath, 2001). To satisfy both requirements, they found the convergent line is developing ambidexterity. For example, He and Wong (2004) demonstrate that the interaction between explorative and exploitative innovation is positively associated with sales growth. March and Levinthal (1991) also state that keeping balance between exploitation and exploration is favorable to firm's long-term success. O'relly and Tushman (2004) reconfirmed that several ambidextrous organizations are well adjusted and keeping a balance between exploration and exploitation without increasing their costs.

2.3 Empowerment inside organization

Based on Zahra and George (2002)'s reconceptualization of absorptive capacity, Todorova and Durisin (2007) reintroduce the model of absorptive capacity, Todorova and Durisin (2007) reintroduced Zahra and George's (2002) reconceptualization of absorptive capacity, which labels the capabilities of a firm in order to explain their innovation ability in a way that purposely adopts and internalizes external knowledge. They add the concept of power relationships to answer the questions: why only some of specific resources are used by the organization, and why some of the people execute their power according to their preference (Pfeffer, 1981). A large number of open innovation projects operate by top-down methods under the great support of executive officers. It is not too farfetched to assume that the amount of power granted to boundary spanners will have a different influence.

Empowerment is one factor which calls on boundary spanning roles to influence organizational performance. According to Conger and Kanungo (1988), empowerment is the motivational concept of self-efficacy. Empowerment has been recognized as the capability to perform momentous work that can impact a working organization (Kirkman and Rosen, 1999). Several studies show the relationship between empowerment and the team's productivity. The more empowered teams were more productive. In other words, self-managing teams are associated with high productivity and quality of product In previous works about empowerment, Kirkman and Rosen (1999) considered four dimensions of empowerment, which are composed of potency, meaningfulness, autonomy, and impact. In our research, we narrow these dimensions down from four to two; autonomy and impact.

Autonomy parallels the self-determination which is the degree of a team member's right to freedom (Hackman, 1987). Because the four dimensions of empowerment are additively combined, it is still possible to measure it through two dimensions (Spreitzer, 1995). It also refers to organizational structures, which can establish clear vision and goal (Seibert et al., 2004). Therefore, high levels of team autonomy impact refer the degree to which members can affect outcomes at work Impact is the opposite of learned helplessness. Learned helplessness occurs when team members feel they have no control over their situation inside a team or organization. Accordingly, they act in a helpless manner, which overlooks opportunities for change. On the other hand, members inside team feel an impact when their team produces important and meaningful work for their organization, by their action. (Hackman, 1987).

2.4 Diversity inside organization

Diversity refers to individuals' differences, which may bring the perception that another person is different from one's self (Jackson, 1992, Triandis, 1994, Williams and O'Reilly, 1998). (Jackson, 1992, Triandis, 1994, Williams and O'Reilly, 1998). Diversity brings high variances in ideas and creativity; organizations with a high level of diversity can generate an improved situation that can lead to better performance or a chance to adopt new knowledge. Conversely, a uniform constitution of organizational units would likely result in blinding their members in ignorance and resistance against new knowledge with which they are not familiar. There are numerous examples of studies that show diversity can contribute to organizational performance. However, before considering the effect of diversity, we need to see it as a dichotomous way of thinking. First, demographic diversity presents various differences in age, gender and ethnicity. Demographic diversity can affect the entire group and organization performance (Sessa et al., 1995). O'Reilly et. al (1989) suggest that a unit's demographic diversity affects outcomes and makes it easier to understand both group and individual functioning. Moreover, there are several studies that show organizational demographics are related to outcomes such as innovation (O'Reilly & Flatt, 1989), individual performance (Tsui and O'Reilly, 1989), and communication (Zenger and Lawrence, 1989). There are various names for demographic diversity, such as, category diversity. This also refers to explicit differences among group members in a social category. This diversity characteristic is decided by their race, gender and so on (Jackson, 1992, Pelled et al., 1999) However, some are concerned that demographic diversity could be problematic, because it may be conceptualized as separation, variety and disparity (Priem et al., 1999).

As organizations are increasingly concerned about forming cross-functional teams composed of functionally different members, there is interest in informational or functional diversity. We can find the difference in behavior while the units face a new task or coordinate a routine task between

informational diversity units and demographic diversity units. Even though functional diversity is less visible than demographic diversity, units which have functional diversity can have a broad range of a task-relevant knowledge, skills, and abilities (Daan & Carsten, 2004). It is because cross-functional units consist of members from different backgrounds that the unit's knowledge is accumulated from each member's diverse knowledge. According to Ancona and Caldwell (1992), functional diversity increases technical innovation and performance by communicating with an external source. Besides, functional diversity can attribute to qualitative differences inside the unit. Even though there are some studies that suggest functional diversity could negatively affect a firm's beneficial effect, we consider this construct as one variable, which maximizes capabilities or boundary spanning roles. In our research, the diversity of a unit signifies functional diversity

III. RESEARCH MODEL AND HYPOTHESES

The unit of analysis in our study is an organizational unit or team, rather than a company. Looking at individual units makes it much easier to apprehend the detailed dynamics of knowledge acquisition and integration. Ambidexterity is posited as the mediator between the boundary spanning and the organizational performance. Boundary spanners are empowered persons who have communication skills and influence members inside the organization. They stay in the interface between the internal and external channels so that they can help organization members to acquire new knowledge. Therefore, boundary spanning likely has a positive impact on the organizational unit's ambidexterity by providing a good balance between exploration and exploitation. Even though some may argue that boundary spanning and the existence of excessive new knowledge can confuse and slow down the process of knowledge exploitation, we argue that both exploitation and exploration will be positively effected in our model.

Hypothesis 1: Boundary spanning will positively influence ambidexterity of the organizational unit.
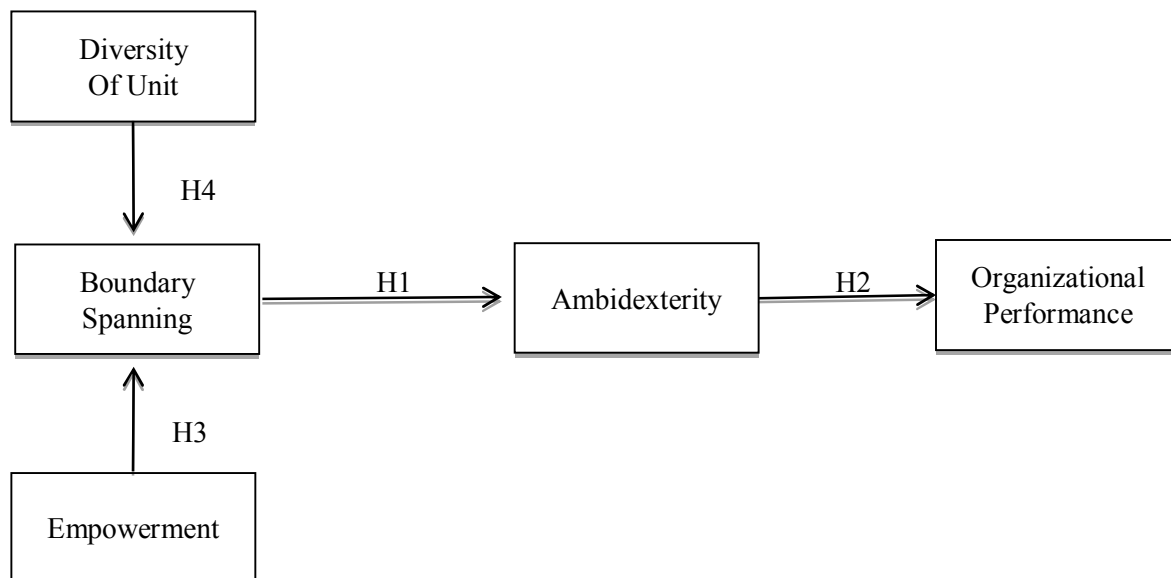
Figure 1. Research model of hypotheses I.

Several studies about organizational learning and organizational theory examine the link between ambidexterity and organizational performance. They argue that maintaining exploration and exploitation simultaneously achieves a greater level of performance and brings competitive advantage to their organization. For example, Birkinshaw and Gibson (2004) showed the correlation between ambidexterity and business unit performance. In addition, Jansen et. al (2006) empirically concluded

that pursuing exploitative and explorative innovation is very beneficial to a unit's performance. The idea that ambidexterity will positively interact with organizational performance is a matter of course. Whereas most of the researchers capture organizational performance using financial results, we measure this construct through perceived performance. Since our analysis is team-level, it is hard to measure financial performance such as ROI and sales growth.

Hypothesis 2: Ambidexterity will positively influence organizational performance.

A boundary spanner is the authorized person who can control the group's environment. This person needs to push a project forward by scanning both inside and outside of the boundaries. It is hard to imagine that boundary spanners can perform their role without authority. To cover a wide range of environments from internal to external, the boundary spanner role should have power, which allows them to freely convert their ideas into action. Empowerment is needed to understand organizational circumstances, which utilize specific resources or is affected by some executives. Several studies have shown that empowerment is directly related to a team's productivity. Thus, the more empowered team was more productive. In our research, we think empowerment is indirectly related to organizational performance, while it is positively affected by boundary spanning.

Hypothesis 3: Empowerment will positively influence boundary spanning

Normally, a high level of diversity creates a high responsivity to change. It is because new and novel ideas can be easily accepted by the diverse members, while uniform member compositions can create difficulty in the process of identifying opportunities from new knowledge and exploiting them. Diversity is divided into two characteristics; demographic functional. Demographic diversity deals with gender, ethnicity, and age, while functional diversity deals with the task-relevant knowledge, skills, and abilities (Daan & Carsten, 2004). Ancona and Caldwell (1992) mentioned that functional diversity attributes technical innovation and organizational performance. Thus, the idea that diversity would have some effect in the relation to boundary spanning came up. Therefore, diversity will likely moderate the degree of the influence between the boundary spanning roles and the organizational ambidexterity.

Hypothesis 4: Diversity in an organizational unit will positively influence boundary spanning.
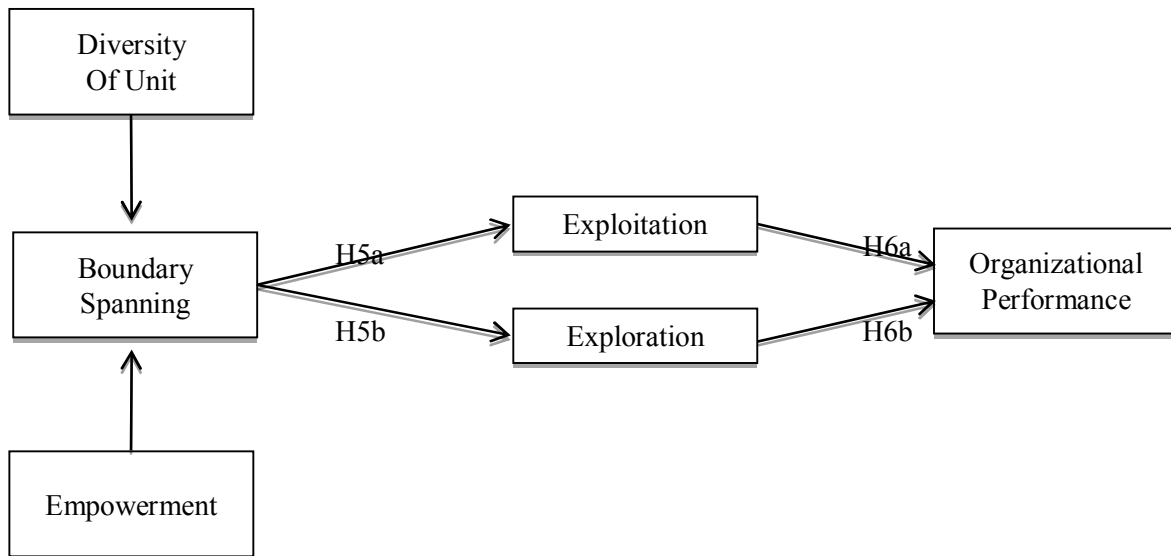
Figure 2. . Research model of hypotheses II .

Ambidexterity is composed of the two variables, exploration and exploitation (see Figure 2). In our research, we verify the hypothesis of an ambidexterity construct through two steps. First, we measure the impact of exploration and exploitation separately. After getting the result, we combine the latent variable scores of exploration and exploitation to get a score of ambidexterity.

Hypothesis 5a: Boundary spanning will positively influence knowledge exploration.
Hypothesis 5b: Boundary spanning will positively influence knowledge exploitation.

Consequently, hypothesis 6a and 6b are defined as both exploitation and exploration will positively influence organizational performance.

Hypothesis 6a: Knowledge exploitation will positively influence organizational performance.
Hypothesis 6b: Knowledge exploration will positively influence organizational performance.

IV. RESEARCH METHOD

4.1 Study design and Data collection

The following empirical analysis is based on data gathered in May 2011. We began the data collection in two different ways. First, we sent an e-mail using an e-mail list, which we personally gathered, together with a list from a Research Company. The target of our survey was employees who work for various R&D departments in Korea. We received a total of 254 survey responses representing a 12.5% response rate. Among those, we had to eliminate some data which came from the same companies and some data which consistently choose the same number. Finally, we were able to gather data from 154 surveys. The average participant age was from the 30-39 level, 72.7% were male and 27.3% were female. For education, 52% of respondents have a bachelor's degree, 35.7% of respondents have a master's degree, and 17% of respondents have doctoral degree. In case of company size, 29.9% of respondents were working for a large company, 8.4% for a mid-sized company, 43.5% for a small company, 16.2% for a research laboratory, and 2% for a public institution. Those demographic profiles were used as control variables.

Table 1. Demographic profile and descriptive statistics of surveyed people

Measures and items	Frequency	Percentage
Gender		
Male	112	72.7
Female	42	27.3
Age		
20-29	40	26.0
30-39	62	40.3
40-49	40	26.0
50-59	11	7.1
60-over	1	0.6
Education		
Bachelor's degree	82	52.0
Master's degree	55	35.7
Doctor's degree	17	12.3
Business type		
Large company	46	29.9
Middle company	13	8.4
Small company	67	43.5
Research laboratory	25	16.2
Public institution	3	2.0

N=154, Response rate: 12.5%

4.2 Measures

The questionnaire used a 5-point Likert-type scale where 1=completely disagree, 5=completely agree. The measurement instrument items were adapted from previous studies, and translated into Korean to suit the context of the present study. To avoid making errors when we translated the instrument items from English to Korean, we rechecked the translations with five master's students and two professors. The survey contained a series of 5-point Likert scale questions. Each instrument consisted of a different number of items. The boundary spanning items are composed of five statements include "My team has one or more members, who are a part of a project team which facilitates coordination with those outside of the team" and "My team scans the environment inside or outside the organization for technical ideas and expertise". These questions are adapted from Levina and Vaast (2005) and Ancona and Deborah G, Caldwell& David F (1992). The ambidexterity items were asked through exploitation and exploration respectively. The exploitation items were drafted to discover whether their team tended to discover a new field and the exploration items were drafted to discover whether their team tends to focus on existing resources. Those items were adapted from research of Jansen (2005). Ambidexterity is composed of two variables, which are exploration and exploitation, it is considered as the product of exploitation and exploration. Therefore, we calculated organizational ambidexterity by adding exploration and exploitation (hereafter the additive model). To measure ambidexterity, the results from the PLS algorithm were used. These results give us each latent variable score. We measured ambidexterity thought the process of combining the score of exploration and exploitation. The diversity of the unit was measured by three items adopted from the instrument developed by Egan & O'Reilly (1992). In this part, we asked whether their team is composed of members who have various majors and job experiences. The empowerment is adopted from Lam et.al (2004). Three items include the questions "My team members who coordinate activities with external groups can determine how things are done in the team" and "My team members who coordinate activities with the external group have a lot of job-related responsibilities". Finally, we measured team performance. Whereas most researchers capture organizational performance using financial results, we measured this construct using perceived performance. There are several ways to measure performance. In our research, we adopted instruments from Lam et. al (2004). The previous studies include those questions "This team is very competent," "This team gets its work done very effectively."

4.3 Data analysis

We tested the hypotheses by utilizing the partial least squares (PLS) with the software package SmartPLS 2.0. Even if LISEL is the best-known casual modeling technique, it is not suited to small

data samples (Fornell, 1982), and can bring improper solutions in some cases (Fornell and Bookstein, 1982). Partial least squares can be used to analyze the measurement and structural model with multi-item constructs that include direct, indirect, and interaction effects, and have become extensively utilized in information systems research (Chin and Todd, 1995, Gefen and Straub, 1997). Furthermore, partial least squares (PLS) have fewer restrictions compared with LISEL or EQS when we consider sample size and data distributions. Partial least squares (PLS) demands only ten times the number of independent variables that affect dependent variables in the largest construct (Chin and Newsted, 1999). In this research, we have six latent variables. Thus, our sample size of 154 can be considered adequate for this method. The research model consists of six latent variables and in this case, all constructs were "reflective" indicators. Reflective indicators indicate a construct where the observable items are expressed as a function of the construct (Bontis, 1998). Figure 2 shows our construct of the model in SmartPLS2.0.

Table 2. Outer Loading score

	BS	DIV	EMP	EXI	EXR	PER
BS1	0.74					
BS2	0.75					
BS3	0.76					
BS4	0.73					
BS5	-0.23					
DIV1		0.89				
DIV2		0.90				
DIV3		-0.10				
EMP1			0.83			
EMP2			0.85			
EMP3			0.87			
EXI1				0.47		
EXI2				0.78		
EXI3				0.78		
EXI4				0.77		
EXR1					0.80	
EXR2					0.10	
EXR3					0.75	
EXR4					0.77	
PER1						0.86
PER2						0.92
PER3						0.87

BS= Boundary spanning;   DIV=Diversity of unit;   EXI: Exploitation;   EXR: Exploration
EMP=Empowerment;   AMBI=Ambidexterity;   PER=Performance

Before assessing construct reliability and other validity tests, we checked the outer loading between indicators, and latent variables through the PLS algorithm. Originally, we had adopted a total of 22 instrument indicators from previous studies. However, we had to remove four, which are marked in Table 2. These four items were scoring quite low compared to other indicators within the same construct. As you can see in Table 2, the forth indicator of boundary spanning, the third indicator of diversity of unit, the first indicator of exploitation, and the second indicator of exploration scored -0.233, -0.098, 0.467, and 0.103 respectively. Since the outer loading score presents how much the indicator explains the latent variable, those four indicators are barely suitable for explaining each latent variable. As those four indicators were adopted from previous studies, we think there is a reason why some outer loading scores are fairly low. Three questionnaires were "someone who facilitates coordination with outside sources receives an assignment without the manpower to complete it", "My team does not accept to performing projects, which go beyond the range of existing products and services", "Each of team members has not various job experiences ." Those three questions were reverse questions. We intentionally changed the original questionnaires to a reversed one. Considering our questionnaire items were all mixed, irrespective of construct, it was possibly confusing the respondents. In case of the questionnaire for EXI1, which is "My team's major customers are in similar industries", it seems inappropriate for our whole context. Finally, we were able to extract four indicators of boundary spanning, two indicators of diversity of unit, three indicators of empowerment, three indicators of exploitation, three indicator of exploration, and three indicators of performance for a total 18 indicators.

We then checked for possible common method variance with Haman's single-factor test (Podsakoff, 1986 and Modern MTMM technique using PLS (Podsakoff, MacKenzie et al, 2003). According to Harman's single-factor test, common method variance occurs if a single factor accounts for the majority of the covariance in the dependent and independent variables. An exploratory factor analysis (EFA) of all of our items shows five factors explaining 60.12% of the variance in our research construct (see Table 3). We found the first factor explains 29.5% and the last factor explains 5.42% of the total variance. Since we didn't find one factor explaining a majority of the covariance, we verified that common method variance was not a problem in our research. Second, according to the Modern MTMM technique using confirmatory factor analysis, we checked a correlation coefficient between each latent variable. When we found that all correlation coefficients were less 0.65, we rechecked that there was no common method bias.

Table 3. Extraction Method: Principal Component Analysis

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.481	29.460	29.460	6.481	**29.460**	29.460
2	2.383	10.833	40.294	2.383	**10.833**	40.294
3	1.836	8.345	48.639	1.836	**8.345**	48.639
4	1.343	6.104	54.743	1.343	**6.104**	54.743
5	1.193	5.421	60.163	1.193	**5.421**	60.163

Non-response is a potential source of bias in survey studies. Research has presented that late respondents are often similar to non-respondents. Turckman (1999) recommended that if fewer than 80% of people who take the questionnaire complete and return it, the researcher need to try to check non-response bias by comparing early to late respondents. Thus, by comparing initial and late respondents, we checked the potential bias. Initial respondents were those who had completed the questionnaire within one third point, while late respondents were those who completed it after the specific period. Responses for all the questions were tested for possible non-response bias using the chi-square test to compare early and late responses. We found that there were no significant differences between initial respondents and late respondents, so the results are understandable to the target population. This suggests that non-response bias is unlikely to be a major problem in this study.

Examining construct reliability, discriminant validity and convergent validity PLS assesses the measurement model Figure 2 and 3 show the results of measurement. Figure 3 is the model, which shows the product of exploitation and exploration. The results between 'diversity of unit and boundary spanning' and 'empowerment and boundary spanning' are the same, while other paths show different results because of ambidexterity. To demonstrate construct reliability, three evaluations were done. First, Cronbach's alpha values were checked. Most items present loading of more than 0.7 while one loading remains less than the recommended score. Along the same lines, the composite reliability was checked. As recommended, the composite reliability were all higher than 0.7 without any exception. Even if the Cronbach's alpha value of one construct remains 0.66 which below the recommended score(0.7), the composite reliability scores clearly satisfied the recommended value of 0.7(Chin, 1998). Lastly, the average variance extracted (AVE) was measured and checked. The recommended value of AVE is greater than 0.50. In other words, the average variance extracted which shows that for explain that every construct more than 50% of the variance is explained. Our measures were uniformly high, complying with the recommended score (ranging from 0.55 ~ 0.83) (Fornell & Larcker, 1981). Figure 2 is the result of PLS algorithm and Table 4 include the information of AVE, Composite reliability and Cronbach's α.

Table 4. Construct reliability measures

	AVE	CR	Cronbach's α
B.S	0.55	0.83	0.73
DIV	0.83	0.91	0.80
EMP	0.72	0.89	0.80
EXI	0.63	0.84	0.71
EXR	0.60	0.82	0.66
PER	0.77	0.91	0.85

AVE: Average Variance Extracted(Cutoff value: more than 0.5)

CR: Composite(Construct) Reliability(Cutoff value: more than 0.7)

Cronbach's alpha(Cutoff value: more than 0.7)

To evaluate convergent validity, the loading of each questionnaire item was computed and checked respectively. The most rigorous way to prove convergent validity is verifying the item loading if their values are more than 0.707. The softest way to prove it is checking the minimum value of 0.5 (Barki and Hartwick, 1994). Since all items loaded from 0.73 to 0.92, we can say that the results support the convergent validity without any exception. (see Table 2)

Discriminant validity is assessed using average variance extracted (AVE) and item loading. The results in Table 5 confirm the discriminant validity. To test this validity, average variance extracted for each construct is calculated as the square root of average variance extracted. For adequate discriminant validity, the diagonal of the matrix, which is the square root of the average variance extracted, should be greater than the off-diagonal loading on their appropriate constructs. The boldface figures on the diagonal are the square root of AVE.

Table 5. Square root of AVE

	B.S	DIV	EMP	EXI	EXR	PER
B.S	**0.74**					
DIV	0.27	**0.91**				
EMP	0.52	0.31	**0.85**			
EXI	0.58	0.02	0.36	**0.80**		
EXR	0.56	0.31	0.42	0.49	**0.77**	
PER	0.43	0.28	0.48	0.35	0.62	**0.88**

Overall, the evaluation of our model manifests that all constructs are meeting the requirements of reliability and validity for the purposes of this analysis.
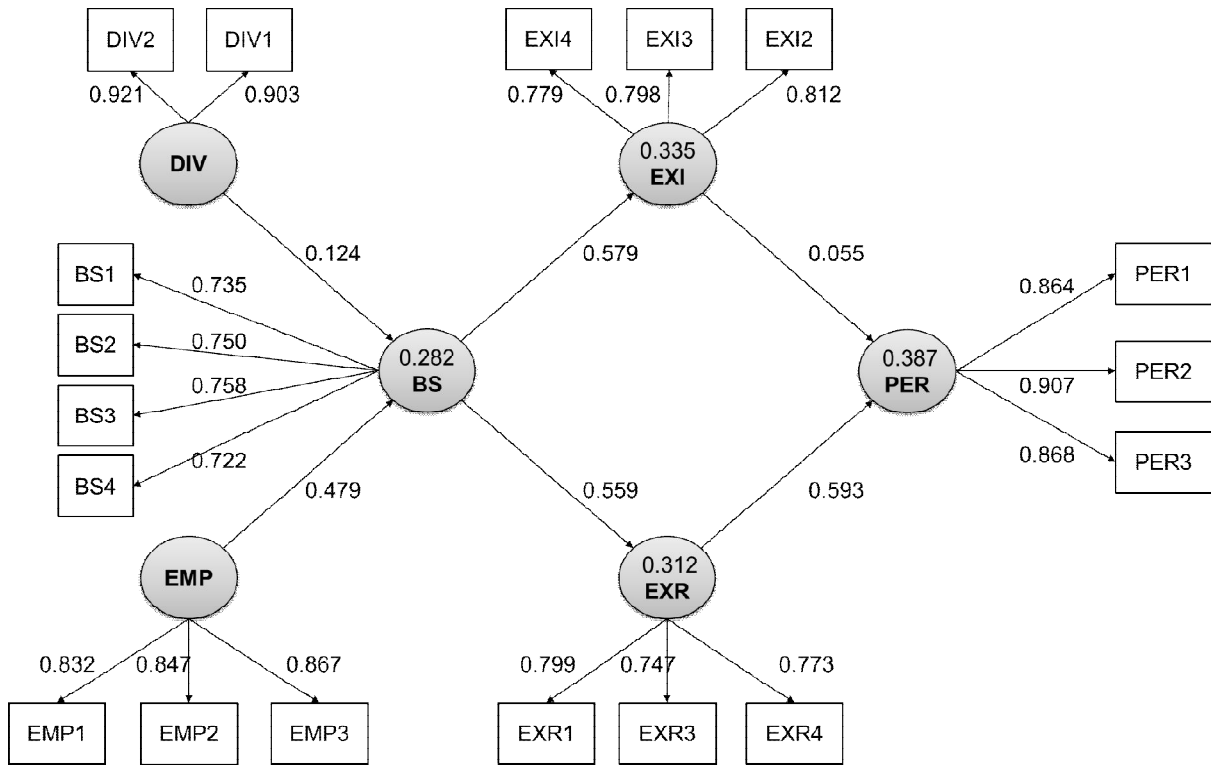
This figure measures exploitation and exploration separately.

Figure 3. The results of PLS algorithm I
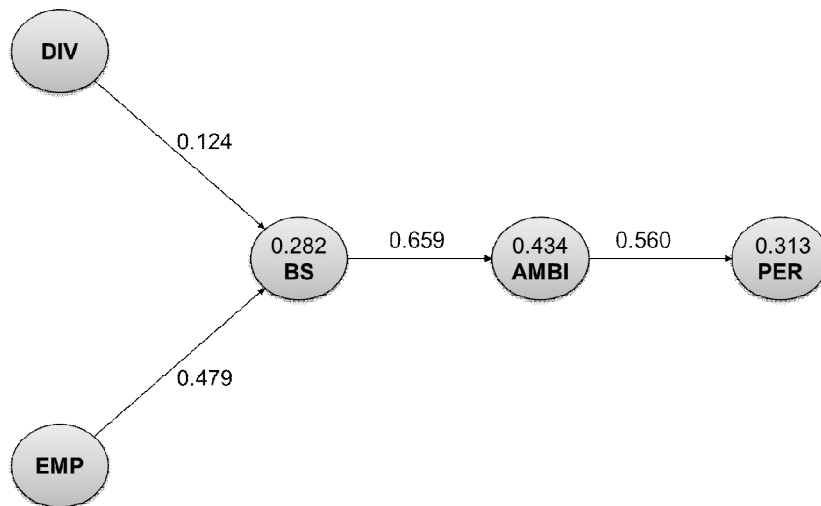
This figure shows the results of combining latent variable (exploitation & exploration) score of constructs.

Figure 4. The results of PLS algorithm II

4.4 Structural model

The structure model was evaluated by the R^2, which represents the predictive power within constructs. In multiple regressions, the R^2 presents the amount of variance explained by the model (Chin, 1998). The overall mode explained 28% of the variance in boundary spanning roles and 43% of the variance in ambidexterity (exploitation=36%, exploration=31%). In addition, the model explained 39% of the variance in performance. According to Cohen (1998), the score of R^2 is divided in three levels, which is high (>=0.26), middle (0.13~0.26), and low (0.2~0.13). As we checked, all R^2 values stay at the level of 'high'. Also, Tenenhaus et. al (2005) suggested the way to check Goodness of fit. It should be at least over 0.1, and over 0.36 is considered high. In this research, we got 0.47.

Table 6. Goodness of Fitvalue

	Communality	R^2
BS	0.55	0.28
DIV	0.83	
EMP	0.72	
EXI	0.63	0.33
EXR	0.60	0.31
PER	0.77	0.38
Goodness of Fit value	0.47	

4.5 Control variable analysis

We included a number of control variables in the analyses. Even if the control variable is not the independent variable in the analysis, it could affect the results of the experiment. We asked respondents personal information, including gender, education, status in their unit, and age. Personal information was asked based on human capital variables (education, working experience), and demographic variables (gender, employment status).

First, a dummy variable was used for the measurement of gender (0=male, 1=female). In the case of the age variable, we divided age into six levels, which are 20-29, 30-39, 40-49, 50-59 and over 60. The education variable was measured by three groups, which are bachelor's degree group, master's degree group, and doctoral degree group. The status variable measurements were employee, deputy section chief, section chief, department head, deputy head of department and executive. Using SmartPLS again, we analyzed the linear relationship among ambidexterity, boundary spanning, and each control variable. We were able to arrange control variables through age and education. When age

was the control variable, it didn't change any of our results. Except in diversity of unit, all hypotheses were supported. Along the same line, the education control variable didn't influence either dependent variable.
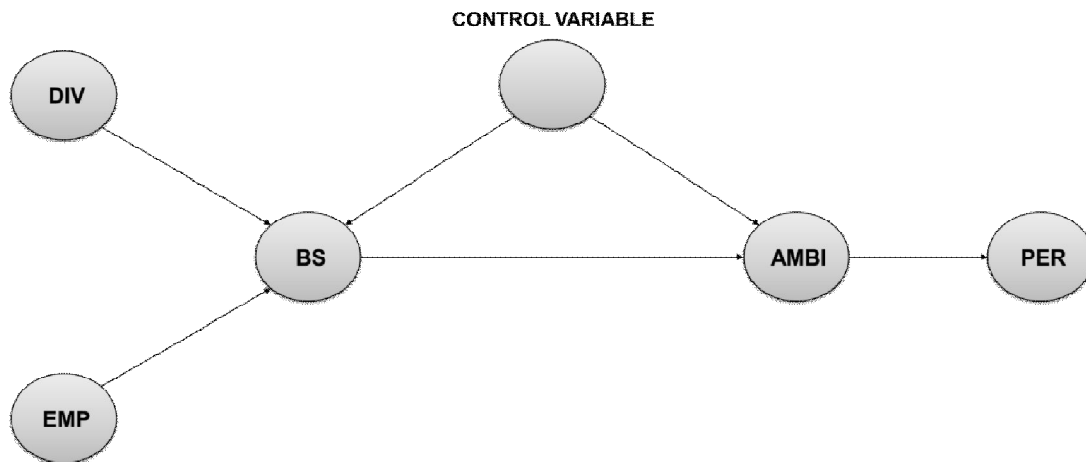

Figure 5. The model of control variable analysis

Table 7. The results of control variable analysis

	T Statistics (Education)	T Statistics (Age)
AMBI → PER	6.859868	7.077073
B.S → AMBI	12.358052	12.944849
DIV → B.S	1.478389	1.50834
EMP → B.S	6.082629	6.898324

Ⅴ. RESULTS

After accessing the construct validity and goodness of fit, we tested our hypotheses through the PLS structural model (see Figure 5, 6). The bootstrapping (with 500 subsamples) was performed to present the statistical significance of each path coefficient through t-test. The samples consisted of 154 various Korean R&D department employees. To assess the ambidexterity, we followed two-step procedure. First, we examined the relationship among the items. As shown in Figure 5, we examine the influence of exploitation and exploration. Second, we combine exploration and exploitation to check the influence of ambidexterity (See Figure 6).

As shown in Figure 6 and Table 8, boundary spanning is positively related to the ambidexterity (p<0.001). Hence, Hypotheses 1 is supported. Boundary spanning had a significant effect on both exploration and exploitation (p<0.001) as expected in Hypothesis 2a and Hypothesis 2b. Diversity of unit is not significantly related to boundary spanning at the p<0.001 level, but empowerment is (p<0.001). These findings provide support for Hypothesis 3, while they reject Hypothesis 4. We ran an additional analysis for ambidexterity. Ambidexterity is positively related to organizational performance (p<0.001). This result supports Hypothesis 5. Consistent with Hypothesis 6b, exploitation had no significant effect on organization performance. The effect was in the hypotheses direction, but was not a significance level within the conventional p<0.05. On the other hand, exploitation is positively related to organizational performance (p<0.001). This finding thus provides support for Hypothesis 6b. In sum, the model test supported all the hypotheses except Hypothesis 4 and for Hypothesis H6a.
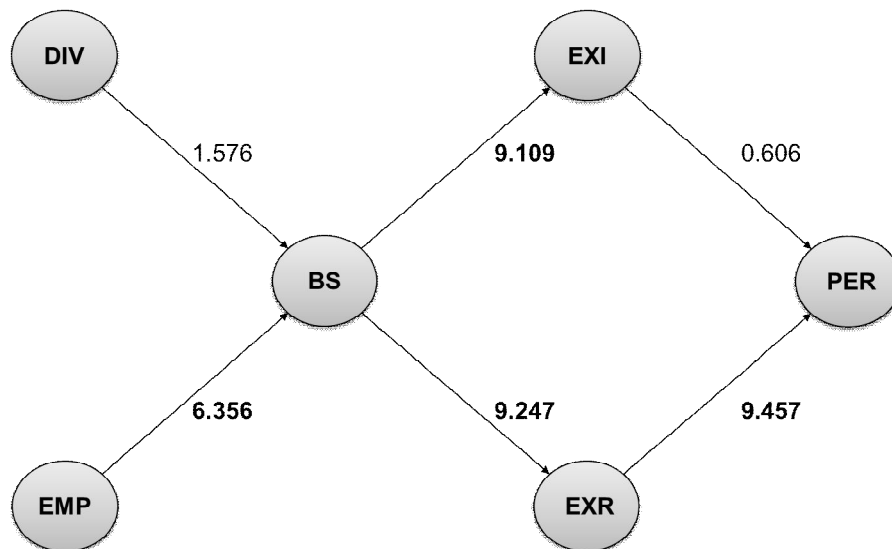

Figure 6. Results of the Bootstrapping on Exploration and Exploitation model (n=500)
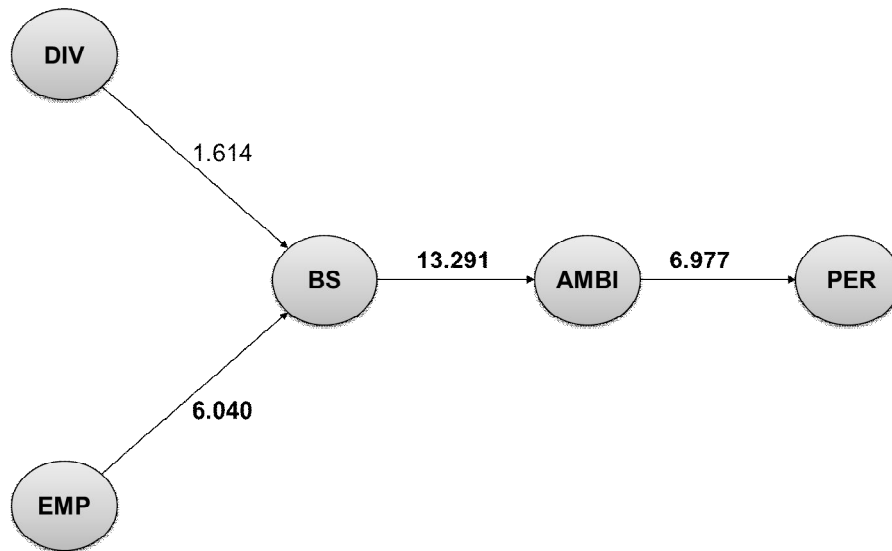
Figure 7. Results of the Bootstrapping on Ambidexterity model (n=500)

Table 8. Results of hypotheses test

	Hypotheses	T-value	Supported?
H 1	Boundary spanning will positively influence ambidexterity of the organizational unit	13.29**	**YES**
H 2	Ambidexterity will positively influence organizational performance	6.98**	**YES**
H 3	Empowerment will positively influence the boundary spanning	6.35**	**YES**
H 4	Diversity in organizational unit will positively influence boundary spanning	1.58	NO
H 5 a	Boundary spanning will positively influence knowledge exploitation	9.25**	**YES**
H 5 b	Boundary spanning will positively influence knowledge exploration	9.11**	**YES**
H 6 a	knowledge exploitation will positively influence organizational performance	0.61	NO
H 6 b	knowledge exploration will positively influence organizational performance	9.46**	**YES**

T-value: p <0.05*, p < 00.1** (two-tailed test).

Ⅵ. DISCUSSION AND IMPLICATION

Recently, burgeoning interests in open innovation and interdisciplinary R&D drew growing attention on the boundary spanning and its impact on innovative culture or capability of organizations. To cope with uncertainty in their business environment, organizations must deal with new knowledge and understand internal dynamics so that they can achieve technological innovation. To have a broad variety of the knowledge base, organization must embrace advanced knowledge through the internal and external channels. In this sense, boundary spanning roles have emerged as the key part that brings organizational innovativeness.

This research was aimed at examining how the boundary spanning roles may successfully cope with ambidexterity and organization performance. To enable such an examination, the empirical research has examined whether pursuing exploitation and exploration simultaneously results in higher levels of organizational performance. Also, it examined how the roles of the diversity within a unit and empowerment can affect boundary spanning roles, as well as the relationship between boundary spanning roles and ambidexterity. The important insight from this study can help with the understanding of the dynamic mechanism of boundary spanning roles and the role of innovative leaders. Also the study provides insight into how inner mechanism boundary spanning roles translate to organization performance through ambidexterity, which is composed of exploration and exploitation. In recent years, empirical results showed those organizational units that pursue organizational innovation mainly focused on organizational or financial performance. However, we realized that even in understanding the antecedents and consequences, innovative activities remain rather unclear. Although prior research suggested that organizational performance is affected by several factors, which include boundary spanning roles and ambidexterity, most research hasn't shown a multilateral effort. Revealing the relationship between organizational performance and ambidexterity or boundary spanning roles was not a meaningful argument because there are lots of studies which prove their relationship. For that reason, our research gives importance to the inner mechanism and how boundary spanning roles translate to organizational performance.

Specifically, our contribution with this paper is settling into two shapes. First, while we establish the relationship between boundary spanning roles and organizational performance, we explore the elements which facilitate these roles. After a broad literature review, we presumed that diversity of the unit and team empowerment would be the important influences on boundary spanning roles in a d dynamic mechanism. We found that the diversity of a unit is insignificant to boundary spanning roles, whereas, empowerment is significantly. Abstractly, there is some opinion that boundary spanners are skilled and proficient individuals but there were no empirical studies, which measure the relationship between boundary spanning roles and power relations. As predicted, when team members feel that they have control over their situation in a team or organization, implementation of boundary spanning

roles can be more effective.

Second, we established the relationship between boundary spanning roles and ambidexterity. Recently, both concepts are considered burgeoning interests in open innovation and interdisciplinary R&D department. Pursuing boundary spanning roles and ambidexterity is associated with the activities, which seek for new opportunity inside a dynamic environment. Nowadays, open innovation is inevitable to gain competitive advantage, thus the role of boundary spanning and ambidexterity is growing in importance. Based on this idea, we presumed that if there is a high level of boundary spanning roles, ambidexterity might have a positive impact on organizational performance.

As a result, detecting internal or external information at the organizational boundaries influences activities which pursue the creation of new knowledge and reinforce existing knowledge. Overall our research suggests to team managers how to compose efficient R&D team to succeed in their business.

Even though we propose several implications in our study, we still need to explain for the rejected hypotheses. Among our eight hypotheses, results didn't provide support for Hypothesis 4 and Hypothesis 6a. Results from our study presented that the diversity of a unit was not significantly related to the boundary spanning roles. At first, we assumed that if a unit has various team composition, it would create a better environment for absorbing new and advanced knowledge from the outside the organization. However, our assumption was not supported by our analysis. To understand the results, we looked in Donnellon's findings. Donnellon (1996) and Jehn (1997) mentioned that cross-functional groups can bring about a result of negative outcomes, such as increased stress and costs. Also this type of group can feel lower group cohesiveness. Keller (2001) studied the direct and indirect effects of functional diversity. He hypothesized functional diversity has an indirect negative effect on cohesiveness, through external communication (Keller, 2001). The indirect path of job stress resulted in lower cohesiveness.

According to Amanson (1996), affective conflict is also one of factors which significantly and negatively related to affective acceptance. In an early phase, we focused on the functional aspect of the diversity of a unit rather than the emotional or affective aspect of diversity. We assume that we overlooked affective conflict. Roloff (1987) said that organizational conflict occurs when members encounter incompatible colleagues who specifically have different ideas, values, attitudes, and goals to utilize the services or product of the organization. However, not every conflict brings negative effects. Several conflict management scholars (Amanson, 1996, Jehn, Northcraft, & Neale, 1999, Rahim, 2001) have suggested that there are some types of conflict, which may have positive effects on the team performance. We think managing team conflict is also a very critical issue to the organization. Overall, we think affective conflict might be the most important factor in bringing about a result which did not support Hypothesis 4.

Also hypothesis 6a which assumed 'knowledge exploitation will positively influence organizational performance' wasn't supported. At the beginning of the research, we looked several

papers, which support our hypothesis even though there are little differences among goals, circumstance, and background. Despite researchers have found knowledge exploitation, and organizational performance had positive relation, we found totally difference results. So, we should consider to difference between our research and prior research works. As mentioned above, we examine the other researches in more detail. Jansen, Van Den Bosch, and Volberda (2006) suggested that understanding antecedent and consequences of both explorative and exploitive innovation is unclear. Therefore, they examined how environmental aspects moderate among explorative innovation, exploitive innovation, organizational performance.

Such dynamic environments and environment competitiveness were the representatives of environmental aspects. Their findings showed that pursuing exploratory innovation is more effective in dynamic environments, while pursuing exploitative innovation is more successful in competitive environments. Thus, to pursue effective exploitative innovation we should examine whether organizations remain with dynamic environments or competitive environments. Environmental dynamism refers to the degree of variability of the environment (Dess and Beard, 1894). This may be characterized by transformation and modification of technologies, product demand or supply of materials. Environmental competitiveness refers to the degree of competition that reveals how many competitors are involved and how big the area is (Birkinshw et al, 1998, Jaworski and Kohli, 1993). On that account, a possible explanation for the insignificant relationship between exploitation and organization performance could be that in our research context, consideration of an environmental aspects may be required to moderate the effective knowledge exploitation. To fully understand the insignificant results, future research should be carried out on whether diversity of a unit is influenced by an affective conflict and knowledge exploitation is affected by environmental aspect in our context.

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APPENDIX: INSTRUMENT

	Questionnaire items	Sources
Boundary Spanning	1. My team has one or more members, whom are a part of a project team which facilitates coordination with outside of the team. 2. My team scans the environment inside or outside the organization for technical ideas and expertise. 3. My team provides someone who coordinates activities with external group the opportunity for professional visibility Ex: Promotion, Bonus). 4. My team does make it clear how should member do the job which coordinate with outside of the team or collects information from outside.	Levina & Vaast (2005) Ancona et al (1992)
Exploitation	1. My team frequently launches new projects to refines the provision of existing products and services. 2. My team launches new projects which lowers the cost of internal processes through process innovation. 3. My team's project are highly related to existing technologies and product.	Jansen (2005)
Exploration	1. My team takes risks to develop new technologies or opportunities. 4. My team launches a project for new products and services. 5. My team is flexible enough to allow us to respond quickly to changes in external environment.	Jansen (2005)
Empowerment	1. My team members who coordinate activities with external groups can determine how things are done in the team. 2. My team members who coordinate activities with external group have a lot of job-related responsibilities. 3. My team members who coordinate activities with external groups have significant influence over what happens in my team.	Van de Ven & Ferry (1980)
Diversity inside firm	1. My team is composed of members who have different major. 2. My team is composed of members with different backgrounds or who have studied different majors.	Tsui, Egan, & O'Reilly (1992)
Performance	1. My team is very competent. 2. My team gets its work done very effectively. 3. My team has performed its job well.	Lam, Schaubroeck & Brown (2004)

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짧은 시간이었지만 많은 정이 쌓인 현주와 의주도 고마워. 항상 잘 따라주고 덕분에 많이 웃었고 즐거웠다. 함께 유니스트의 첫 시작을 했던 재형오빠, 제이슨오빠, 그리고 한나와 김학찬선배님께 감사의 말 전하고 싶어요.

언제나 조건 없는 사랑을 베풀어주시는 우리 가족들, 철없는 막내지만 항상 감사한 마음 간직하고 있습니다.

항상 여러분의 밝은 앞날을 위해 기도하겠습니다. 그리고 언제나 도전을 두려워하지 않는 윤영심 되겠습니다. 사랑합니다.