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Communication for Open Innovation in Japanese Drug Discovery Ventures

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Communication for Open Innovation in Japanese Drug Discovery Ventures

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Abstract: Drug discovery ventures find candidate substances likely to develop into new drugs by selecting and concentrating management resources that specialize in basic and exploratory research and license them to pharmaceutical companies. They conduct R&D activities on the premise of open innovation; however, the number of their licensing cases is small. Therefore, in this study, we conducted a questionnaire survey to find variables that affect the performance of open innovation. Questionnaires were mailed to 349 drug discovery venture companies in Japan (41 addresses unknown), and valid responses were collected from 42 companies (response rate: 13.6%). Using a SEM analysis, we found the importance of communication in open innovation. Communication has direct impact on open innovation and has been found to enhance open innovation through customer orientation. Drug discovery ventures are the ultimate technology-oriented companies, and, while they tend to lower their communication awareness in business negotiations, they must raise their communication awareness to improve the performance of open innovation.

Keywords: Drug discovery ventures, licensing, communication, customer orientation, business negotiations.

Introduction

In open innovation (OI), where drug discovery ventures attempt to sell knowledge products, communication in business negotiations may be important. Many presidents of drug discovery ventures are highly interested in product novelty and have low communication awareness. However, this disregard for communication may hamper OI of drug discovery ventures. This is the study's research question. Promotion, such as advertising and promotional activities, have played important roles in the marketing of companies for selling products. In consumer goods, mass media advertisements such as TV and newspapers for the masses are crucial. In contrast, in production goods, personal sales are often the center of corporate promotion activities rather than advertising. Sales staff visit client companies to sell their products and services and listen to their needs.

What type of promotion strategy should a drug discovery venture take when attempting to sell knowledge goods? The knowledge products of the drug discovery ventures are candidate substances likely to be the source of new drugs. The business model of a drug

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discovery venture is not to complete all R&D by one company but engage in basic and exploratory research, find candidate substances likely to develop into new drugs, and sell them to a buyer company as licensing. The licensed candidate substance is then grown by the buyer company into the final product, a new drug. Basically, drug discovery ventures are conducting R&D on the premise of OI by selecting and concentrating management resources specializing in basic research and exploratory research. Therefore, when drug discovery ventures sell knowledge products during the R&D process, most drug discovery ventures recognize that if the candidate substance is highly novel, it can be sold by itself, and their awareness of promotion is not high. Business negotiations with buyers are indispensable for selling, but only a few companies see business negotiations as a strategy, and only a few consider business negotiations a promotional marketing activity.

Negotiation itself is also extremely difficult. Because a candidate substance is a knowledge product, the essential part of its value is intangible and invisible, making measuring its value difficult. Moreover, its value is often unclear and context-sensitive; thus, the magnitude of its value varies from company to company. As a result, many companies have trouble with business negotiations. Thus, what type of business negotiations should drug discovery ventures have to succeed in licensing?

Difficulty of New Drug Development

In new drug development, competition in obtaining patents faster than other companies is fierce. This is because if one company obtains a patent first, another company cannot subsequently obtain or sell a patent for similar ingredients or a medicinal effect. Furthermore, as the newly developed drug is protected by patents in Japan and the United States for 20 years, monopolizing the profits of developers without suffering profits due to the follow-up of latecomers is possible. As a result, development competition is fierce; however, since drugs have a direct effect on the human body, the company must prove the “effectiveness” and “safety” of the new drug to develop a new one and prepare a large amount of data about each. Therefore, drug discovery R&D is characterized by a complex R&D process and low probability of success, which requires a long development period and a large amount of funds. Specifically, three major processes exist: exploratory research, preclinical research, and clinical trials, and the probability of developing one new drug is only approximately 1/30,000. In addition, it takes more than 10 years and more than 100 billion yen to create one new drug (DiMasi, Hansen, & Grabowski, 2003; Paul et al., 2010). In many cases, it takes about 20 years.

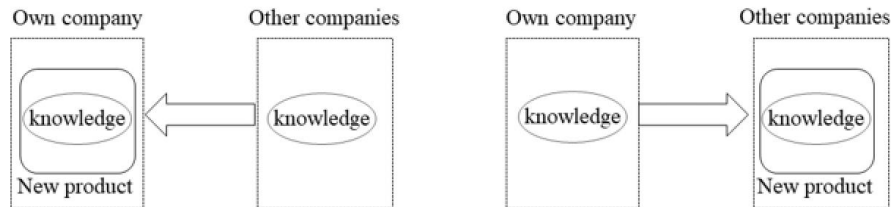
Therefore, having corporate integrity remains advantageous, and since the 1990s, M&A between pharmaceutical companies have become active. As a result, the number of companies that have expanded their scale and secured huge R&D funds has increased. However, M&A are difficult to manage because multiple corporate organizations with different corporate cultures and business styles become one organization. Therefore, some companies choose strategic alliances, which are looser interorganizational relationships than M&A. Various forms of strategic alliances such as joint research and financial assistance exist. In the case of joint research, new drug development takes a long period

of time; thus, many cases exist wherein results are not achieved within the partnership period. Moreover, between rival companies, many alliances exist and often do not work well as they both act opportunistically and not provide important knowledge for their company. Therefore, licensing has increased. While many companies are focusing on difficult diseases such as cancer and Alzheimer's, the development of new drugs is becoming even more difficult as the proteins targeted for new drug development tend deplete. For pharmaceutical companies, having a drug discovery venture manage exploratory research with the lowest probability of success, purchase candidate substances likely to work, and then conduct the subsequent R&D process is more efficient. As a result, pharmaceutical companies aim for licensing to purchase candidate substances. As licensing is regarded as an OI, we will discuss OI and licensing in the next section.

OI and Licensing

Traditionally, corporate R&D has focused on closed innovation, but in recent years, attention on OI has been increasing. Two types of OI exist: an inbound OI that incorporates the knowledge of other companies into the company, and an outbound OI that allows other companies to use company's knowledge (Figure. 1). The outbound licensing of the candidate substances of the interest in this study is outbound OI (Gassmann, 2006; Van de Vrande, De Jong, Vanhaverbeke, & De Rochemont, 2009). Inbound OI has low risk of unintentional leakage of knowledge and technology; however, outbound OI has the possibility of leakage of knowledge and technology (Breschi and Lissoni, 2001), making performing outbound licensing difficult (Chesbrough & Crowther, 2006; Hu, McNamara, & McLoughlin, 2015).

Figure 1
Two types of OI



Licensing is crucial in the R&D of new drug development (Allarakhia & Walsh, 2011), and outbound licensing is beneficial to the pharmaceutical industry (Gassmann, 2006; Tran, Hsuan, & Mahnke, 2011). In addition, the pharmaceutical industry is in an environment where conducting OI such as licensing is easy, and the buyer pharmaceutical companies prefer the inbound licensing to increase the number of clinical trials (Paul et al., 2010). However, outbound licensing is complicated by the intangible and implicit nature of knowledge products (Teece, 2000).

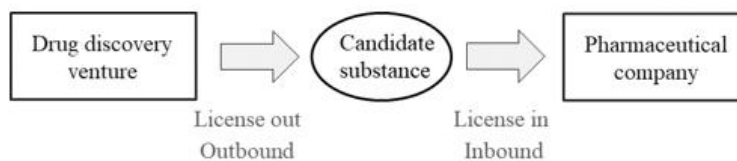
In the same way as the actual number is small, the number of outbound OI is smaller

than that of inbound OI in the study (Felin & Zenger, 2014). Ulrich Lichtenthaler, a leading researcher in outbound OI research, and published more than 20 papers around 2010, most of which were withdrawn due to research misconduct. Therefore, although the analysis results cannot be used as a reference, his research theme was related to the organizational ability of companies when transferring knowledge and technology to the outside, and an analysis of success factors was made. Since his research is based on Teece's (2008, 2011) dynamic capabilities theory, he focuses on knowledge transfer, such as the absorption and transfer capacities of companies. Discussions on absorption capacity in the outbound type have also been made by Hu et al. (2015). Elsewhere, Gassmann (2006); Tran et al. (2011) have presented the benefits of outbound OI to businesses. Although outbound OI research has become accumulated to some extent, few studies on the success factors of outbound OI such as Lichtenthaler (2007, 2008, 2009) exist, and none focus on promotion or communication as a success factor.

However, outbound OI is actively conducted by small companies, and outbound licensing sales is the main activity (Helfat & Quinn, 2006). Particularly, companies with higher legal protection are practicing outbound OI. A company with a high degree of legal protection is a drug discovery venture that has a candidate substance for which a material patent has been obtained. Recently, an increasing number of drug discovery ventures have been developing business models that assume outbound licensing. OI is often implemented between pharmaceutical companies and drug discovery ventures, as there are reasons to seek OI. According to Odagiri (2007), far more OIs in the R&D of pharmaceutical companies than the average of other manufacturing industries exist.

Licensing is the main activity of OI in drug discovery, and there are two activities; outbound licensing and inbound licensing (Figure. 2). Outbound licensing obtains profits by selling the advanced knowledge and technology that the company has done in-house to other companies when continuing development in-house is technically and financially difficult. In contrast, inbound licensing introduces the knowledge of other companies more effective than that of the company under the competition for new product development with competitors, and to conduct the new product development process after that. Applying this relationship to the case of drug discovery, the seller who does the outbound licensing is often a drug discovery venture, and the buyer who does the inbound licensing is a pharmaceutical company, and the knowledge products traded between the two are candidate substances (Figure 2).

Figure 2
Licensing relationship



If both sellers and buyers desire licensing, the number of licensing will likely increase,

but the number of licensing in drug discovery is small (Wakutsu, 2015). Therefore, to identify the factors that make licensing successful, we will conduct a questionnaire survey in the next section.

Questionnaire Survey

Hypothesis Setting

Presidents of drug discovery ventures were often drug discovery researchers at a pharmaceutical company or those who have conducted basic research at a university. They are willing to leave their existing organizations and begin drug discovery ventures as they think their knowledge and candidate substances are excellent and they will succeed. We found the following four points from a qualitative interview survey in another paper. (1) The presidents of many drug discovery ventures recognize that the novelty of candidate substances is important, and the more innovative it is the better. (2) If the candidate substance is highly innovative, it can be easily licensed out. (3) Selling how innovative the candidate substance is in promotion of buyers, that is, in business negotiations with buyers, is important. (4) Product delivery after concluding the contract is the delivery of the actual candidate substance, such as disclosure of the chemical formula if it is a compound, and tacit knowledge does not accompany it.

Based on the statements of the presidents of drug discovery ventures, “the more innovative the candidate substance, the more OI is possible.” The attitude of neglecting promotion is due to the emphasis on the latest knowledge and the fact that several managers are science researchers also leads to the idea of focusing on the latest knowledge. While many of them believe that “if the candidate substance is highly innovative, it can be easily licensed out,” others have the contradictory opinions that “even if the candidate substance is highly innovative, it cannot be easily licensed out.” The latter opinion is consistent with that of Wakutsu (2015), who highlighted that the number of licensing is small. In that case, we question the recognition that “the more innovative the candidate substance, the more OI is possible.” Evidently, product novelty is important, but whether it is adequate or not is uncertain. Basically, in addition to product novelty, an indispensable factor for OI exists, which is a promotion that many drug discovery ventures neglect. Promotion remains important for candidate substances as well as general products, and it may be necessary not only for selling the product but also targeting prospective buyers and understanding their needs. B2B companies that handle production goods attach great importance to personal sales, that is, sales (*eigyō*), in promotion. Sales in Japan also covers marketing and consultation (proposals for problem solving) with client companies and has three main roles. The first is determining if the buyer is a customer, that is, if the buyer is willing to buy. Sales activities to companies not willing to buy only waste their time and effort, and a sales contract cannot be completed. According to Nishimura (2015), drug discovery ventures have difficulty succeeding even if they visit pharmaceutical companies with low interest. Therefore, knowing how interested the buyer is in its product is important. The other two roles are understanding and responding to customer

needs. After determining and clarifying the buyer's, responding to and meeting customer needs becomes necessary.

The above may also apply to drug discovery ventures that strive for product novelty. Basically, the more customer oriented a business is, the higher is the sales performance (Jaramillo, Ladik, Marshall, & Mulki, 2007) may also apply to technology-oriented drug discovery. In this study, sales are OI.

H1: The more customer oriented, the higher the OI performance.

To be customer oriented, communication is important. Many drug discovery venture presidents recognize that selling how innovative the candidate substance in business negotiations to buyers is important, but a sales contract being concluded only by selling is rare. By communicating with customers, knowing the three roles of sales mentioned above, that is, how interested the buyer is in their products and understanding and responding to their needs is important. As Elsbach (2003) highlights, selling an original idea to someone you meet for the first time, and trying to convey its value is rejected by decision makers who do not understand it. Therefore, rather than merely trying to convey the value of our products, understanding and responding to customer needs becomes the purpose of communication.

H2: The better the communication, the higher the OI performance.

In personal sales, a relationship is created between seller and buyer through repeated business negotiation activities. As a result of communication, trust increases. As many drug discovery venture presidents recognize, if product delivery after conclusion of the contract is the delivery of the actual candidate substance, since it only constitutes the delivery of explicit knowledge, a relationship with the buyer may not be necessary. However, if a product requires tacit knowledge, having trust between the seller and buyer is better. Building relationships of trust creates mutually beneficial cooperative behavior between partners, enabling coordination between organizations and tacit knowledge sharing (Das & Teng, 1998; Dyer & Chu, 2000). Many others, such as Smith, Carroll, and Ashford (1995); Doz (1996), have highlighted that trust enhances collaboration. A view exists wherein relationship between the two becomes stable and evolving because trust activates the communication (Uzzi, 1997). Trust is beneficial to OI if licensing practices are viewed as a collaboration.

H3: The higher the trust between the two, the higher the OI performance.

Communication not only directly affects OI (H2) but also affects customer orientation and trust.

H4: The better communication, the more customer oriented.

H5: The better communication, the higher the trust between the two.

Furthermore, as it is the attitude of emphasizing business negotiations that activates communication, we use the emphasis on business negotiations as an explanatory variable.

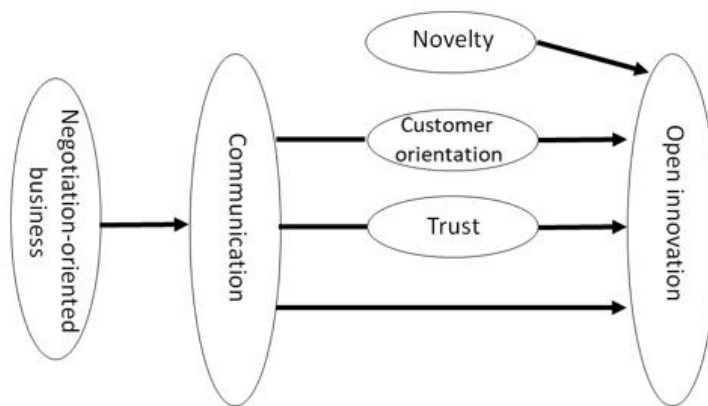
H6: The more business negotiations are emphasized, the higher the OI performance.

Based on an interview survey by us, many presidents emphasized the novelty of candidate substances. Therefore, we set the following hypothesis:

H7: The higher the novelty of knowledge, the higher the OI performance.

The above seven hypotheses are presented in Figure 3.

Figure 3
Hypothetical model



Method

We targeted Japanese drug discovery ventures engaged in drug discovery activities listed in Nikkei Biotech's "Bio-Venture Taizen 2017-2018" and "Bio-Venture Taizen 2019-2020." Although they are the same book, some of the companies listed are different because of the different years of publication; thus, we targeted the companies listed in either, and 349 companies were applicable. We browsed the homepages of all 349 companies and mailed a questionnaire to the address listed on the homepage, but 41 returned with an unknown address. Basically, we sent 308 mails. As a result, we gathered responses from 42 companies, and all of which were valid responses (response rate was 13.6%). Therefore, the number of survey samples was 42.

In the questionnaire, after asking the attribute items, we asked about the content of business negotiation, the relationship with the buyer, the recognition of the business negotiation, and so on. These questions are mainly in the Likert format, and are divided

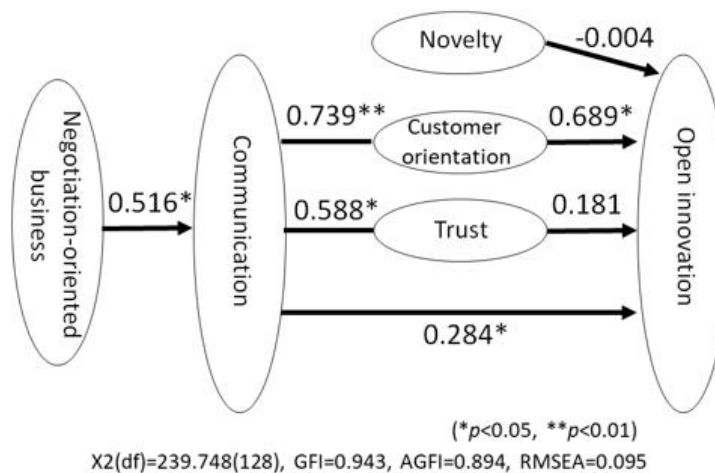
into five stages from “5: I agree very much” to “1: I don’t agree at all.” The questionnaire’s response period was from January 9th (Thursday) to 23rd (Thursday), 2020, and the presidents of drug discovery ventures answered.

Results of the Analysis

Table 1 presented the mean and standard deviation of each question item as variables and Cronbach’s α coefficient. First, we would like to add a little explanation about the “OI performance” variable. The questionnaire asked respondents the actual number of products licensed out so far. As a result, many answers were one or two. We thought it inappropriate to measure “OI performance” with this number as a difference in the amount of money sold even for the same one exists. We used the question items “your company’s sales and profits are going well” and “you are satisfied with your company’s performance.” In addition to license-out as the source of income for drug discovery ventures, some companies also undertake analysis and inspection contracts. However, since their core business is drug discovery activities and their main income comes from license outs, measuring the “OI performance” variable with these two questions is reasonable.

According to Table 1, the average value of these questions regarding sales/income and performance is low, and the presidents (respondents) are not satisfied with their companies’ current state of their OI. Considering that the average value of the question items regarding “novelty” is high, we can determine that many presidents recognize that out-bound licensing has not been successfully executed despite the high novelty of the product.

Figure 4
Result of analysis



Even the lowest Cronbach’s α coefficient of the construct is 0.709 for time, which exceeds the standard value of the guideline, and reliability is confirmed. The standardized

estimates of the paths from latent variables to observed variables were all 0.5 or higher ($p < 0.01$). The average variances extracted (AVEs) of the constructs were all 0.5 or higher, and the CRs (Composite Reliability) were all 0.6 or higher so the convergent validity was also confirmed. Furthermore, because AVEs were larger than the square of the interfactor correlation coefficient, the discriminative validity was confirmed.

Table 1
Averages and standard deviations of each of the variables

Variable	Question text	Average	Standard deviation	Cronbach's alpha
Customer orientation	Your company indicates what the buyer should do next.	3.93	0.936	0.819
	Your company is proposing benefits to the buyer.	4.17	0.753	
	Your company understands the data that the buyer wants.	3.64	0.840	
	Your company responds to the data that the buyer wants.	3.38	0.815	
Communication	Before the business negotiation, your company fully prepares for what it aims to convey.	4.36	0.868	0.794
	What your company wants to convey is completely communicated to the buyer.	3.93	0.910	
	Your company strives to communicate its product's characteristics and values.	4.48	0.732	
	Your company strives to raise buyers' interests.	4.22	1.024	
Trust	Your company has a trusting relationship with the buyer.	3.95	0.722	0.717
	Having a trusting relationship with the buyer is desirable.	4.64	0.781	
Negotiation-oriented business	Your company is highly aware of business negotiation.	3.76	1.019	0.764
	Your business negotiation is at a high level.	3.05	0.785	
Novelty	Your business negotiation is successful.	3.19	0.879	0.888
	Your product has great benefits for the buyer.	4.14	0.899	
	Your products are highly innovative.	4.27	0.938	
	Your product is clearly superior to other companies' products.	4.10	0.850	
Low competition	Your product has few rivals.	3.54	0.965	-
Time	Your product is time-critical in reaching the final product.	3.60	1.068	0.709
	Your product will become obsolete in terms of knowledge and technology.	2.15	1.001	
Open innovation	Your company's sales and profits are going well.	2.64	1.130	0.863
	You are satisfied with your company's performance.			

The results of the SEM analysis are presented in Figure 4. When we checked the goodness-of-fit index, the χ^2 value ($df = 128$) = 239.748 ($p > 0.05$), GFI = 0.943, AGFI = 0.894, and RMSEA = 0.095. The AGFI was below 0.9, but otherwise they were good. The numerical values are standardized path coefficients.

Of the paths that affect open innovation, customer orientation and communication were significant, but trust and novelty were not. The path from communication to customer orientation and the path to trust were both significant, and the path from negotiation-oriented business to communication was also significant. Comparing standardized path coefficients, the path from communication to open innovation mediated by customer orientation is larger than that from communication to open innovation.

The path coefficient from communication to customer orientation was 0.739, and the

pass coefficient from customer orientation to open innovation was 0.689. Both of which were relatively large numbers. Therefore, customer orientation is important for OI. In addition, all path coefficients related to communication are significant, such as negotiation-oriented business to communication, communication to customer orientation, communication to trust, and communication to OI. Therefore, communication is crucial in this model.

Moreover, the path from novelty to open innovation was not significant. Although the path from communication to trust was significant, the path from trust to open innovation was not significant. From the result that trust does not affect open innovation, although increased communication creates a relationship of trust with the buyer, we cannot state that trust enhances the performance of OI.

Discussion

When we tested the hypothesis, we verify that customer orientation (H1) and communication (H2) enhance open innovation, but we could not verify trust (H3). In that sense, trust does not directly enhance OI; however, if the seller and the buyer have a relationship of trust, business negotiations will proceed smoothly and have some positive impact. We were also able to verify that communication enhances customer orientation (H4) and trust (H5), and that negotiation-oriented business enhances communication (H6). In contrast, we could not verify that novelty enhances open innovation (H7). The results are summarized in Table 2.

Table 2
List of hypothesis verification

Hypothesis		
H1	Customer orientation → Open innovation	Supported
H2	Communication → Open innovation	Supported
H3	Trust → Open innovation	-
H4	Communication → Customer orientation	Supported
H5	Communication → Trust	Supported
H6	Negotiation-oriented business → Communication	Supported
H7	Novelty → Open innovation	-

The importance of customer orientation and communication is quite natural from a marketing perspective; however, we can verify that they are also important in OI, especially in technology-oriented companies. Many presidents of drug discovery ventures attach great importance to product novelty and recognize that if the candidate substance is highly innovative, it can be easily licensed out. However, business negotiations are important for concluding a licensing contract. Customer-oriented communication is important. As Kakati (2003) highlights, our product novelty compared to that of other companies does not guarantee commercial success; however, meeting the different needs of each customer leads to a successful company.

In contrast, trust was not a factor enhancing OI. Although the significance of trust could not be found in this questionnaire survey, in the interview survey with the drug discovery ventures presidents by us, answers that acknowledged the significance of trust were provided. In that sense, trust does not directly enhance OI, but it can be considered

as having a sense of trust that facilitates business negotiations and has some positive impact. However, communication increases trust.

The analysis found that “communication enhances customer orientation and trust,” “communication enhances OI through customer orientation,” and “communication plays an important role in this model.” Science researchers are crucial in drug discovery ventures, and researchers oversee top management. It is an ultimate technology-oriented company. While pursuing cutting-edge and advanced knowledge and technology, communication awareness in business negotiations tends to decline relatively, but we have demonstrated that communication is vital for OI. Therefore, companies must raise their communication awareness. Thus, if the product is not novel, performing licensing by communication alone is not possible; thus, raising communication awareness on the premise of product novelty is crucial.

We also confirmed the importance of a negotiation-oriented business attitude. Technology-oriented companies tend to be less aware of business negotiations; however, a negotiation-oriented business attitude is indispensable for enhancing communication. However, the path from novelty to OI was not supported. This hypothesis was not supported in this study, despite what many presidents said in the interview by us. Basically, a product cannot be sold simply because it is novel, and customer orientation and communication are important. Paying attention to the president’s recognition that “the more innovative the candidate substance, the more OI is possible.” Product novelty remains important; however, it is not enough, and OI needs more than product novelty. In fact, drug discovery venture presidents neglect customer orientation and communication.

Conclusion

For venture companies, engaging in all product development in terms of human and money management resources is difficult. Thus, OI specializing in a certain business, such as R&D, is an effective management method. Although unsuitable for large companies in terms of tangible management resources such as company size, venture companies can outperform intangible management resources such as knowledge if it is limited to knowledge in a specific area. Especially in drug discovery ventures, if the value of knowledge is high, even a small venture company should be able to become a leader in OI. However, examining the current situation, the current main actors have been large buyer companies and licensing is not progressing.

Therefore, this research was conducted with an awareness of the problem of the kind of promotion strategy that should be adopted when a drug discovery venture attempts to sell knowledge products. The act of drug discovery ventures selling knowledge products is licensing, which is outbound OI. Therefore, we conducted a quantitative survey targeting drug discovery venture presidents, which are sellers, to identify the factors that enhance OI performance.

In research on OI so far, few previous studies targeting outbound OI types such as licensing. In addition, many previous studies have investigated the impact of external factors such as the large number of competitors and internal factors such as organizational capacity, such as knowledge transfer on OI. Communication was not focused on in

previous studies. In contrast, this study was able to highlight the importance of communication in OI. Communication has direct impact on OI, but in addition, we have found that communication enhances OI through customer orientation. Communication awareness tends to be low in technology-oriented companies; however, raising communication awareness leads to higher OI performance.

In communication, identifying and listening to customer needs is important. The customer needs in this case are mainly side effects data (safety). It then becomes necessary to know the needs of customers, modify the product, and arrange it. The arrangement of this product is useful as the candidate substance is a knowledge product. Knowledge products are context-sensitive in that their values and concerns differ depending on the viewer and user. Thus, instead of presenting the finished product, the seller makes it perfect for the buyer through communication with the buyer.

Finally, we mention this study's limitations. In the questionnaire, we proceeded with the survey without distinguishing whether buyers of drug discovery ventures were domestic or foreign. Although not covered in this study, we found that the results of the questionnaire show that, currently, many drug discovery ventures are more likely to do business with domestic buyers. The average value of the question item "The buyer so far is mainly domestic" was 4.10, and the average value of "The buyer so far is mainly overseas" was 2.50. That many drug ventures can be said to have a greater weight on domestic buyers. In this research, we did not distinguish whether the buyer was domestic or foreign but focused on licensing with foreign pharmaceutical companies will be a future research subject. Communication will become even more important when dealing with foreign companies. However, the required communication skills are expected to differ from those when dealing with domestic companies. We wish to investigate what kind of communication activities are required under various restrictions because the chances of business negotiations will decrease.

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