Formation and Performance of International Industry-academia Collaborative Research Teams

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Abstract: International industry-academia collaborative research (IIACR) is characterized by both international and industry-academia collaboration. This unique combination integrates diverse knowledge, fostering innovative research outcomes. However, geographical and institutional distances between industry and academia hinder researcher connections and team formation. Studies on IIACR teams are scarce, and neither the background underlying their formation nor their impact on research performance has been empirically examined. This study provides one of the first empirical analysis of this underexplored area by identifying the background underlying the formation of IIACR teams and assessing their impact on team performance. This study's significance lies in its unique combination of objective team performance indicators derived from bibliographic data with detailed team formation information obtained through questionnaire surveys, thereby enabling reliable empirical research results. My sample comprised teams with at least one Japanese and one German or American researcher. If the Japanese researcher was affiliated with a firm (university), German or American counterpart was a researcher from a university (firm). A cluster analysis of approximately 160 IIACR teams that published papers between 2017 and 2020 revealed that team formation stems from two primary sources: researchers' networks established through various channels, and the involvement of university industry-academia liaison offices or overseas subsidiaries and their expatriate researchers. Furthermore, Poisson regression analysis demonstrates that teams formed through researchers' initiatives are likely to achieve higher team performance, as measured by the citation counts of papers, than those formed through organizational intervention. Based on these findings, I propose policy measures that promote the formation of researchers' networks, such as support for hosting international conferences and fairs, to help form IIACR teams. I also suggest that intermediary organizations supporting the IIACR can efficiently utilize existing networks among researchers to create promising teams.

Keywords: International collaborative research, Industry-academia collaboration, Team performance, Networking

1. Introduction

Intellectual capital is created by combining previously unconnected elements (Nahapiet and Ghoshal 1998). International industry-academia collaborative research (IIACR), characterized by both international and industry-academia collaborations, provides opportunities to create new combinations of globally distributed elements and is expected to produce innovative research outcomes. However, the geographical and institutional distances between industry and academia hinder research connectivity and team formation (Sauermann and Stephan 2010; Crescenzi, Filippetti, and Iammarino 2017; Subramanian, Lim, and Soh 2013; Lam 2007; Bruneel, D'Este and Salter 2010). Jeong, Choi, and Kim (2014) note that international collaborative research entails costs associated with finding suitable partners. Galán-Muros and Plewa (2016) and Albats, Bogers, and Podmetina (2020) also discussed the connection barrier—the difficulty of identifying appropriate partners and establishing contact—as one of the four barriers to industry-academia collaborations.

Therefore, various organizations assist in partner search for collaborative research projects: these include funding agencies (FAs) for international collaborative research (Sergi, Parker, and Zuckerman 2014) and industry-academia liaison offices, such as Technology Transfer Offices (TTOs) and joint research centers for industry-academia collaborations (Lee 2014; Villani, Rasmussen, and Grimaldi 2017). However, Murakami (2025a) found that ties within industry-academia networks formed through such organizational mediation are stronger in the short term but weaker in the long term than spontaneous network ties among researchers. Consequently, the backgrounds underlying team formation may influence research outcomes.

While there is a wealth of prior studies on industry-academia collaborative research, they do not explicitly distinguish between domestic and international collaborations. Corsi, Fu, and Külzer-Sacilotto (2021) noted that the international dimension of university-industry collaborations has been largely overlooked. No comprehensive analysis has been conducted on the formation backgrounds of IIACR teams that tend to face particularly large connection barriers. Furthermore, the impact of different formation contexts on teams' research and development (R&D) outcomes has not been analyzed. The present study addresses this unexplored area. The significance of this research lies not only in the novelty of the research questions, but also in its analytical approach. Specifically, the present study combines objective team performance measures,

derived from a bibliographic database, with detailed information on team formation obtained through a survey. This combination leads to highly reliable empirical results.

The remainder of this paper is organized as follows. Section 2 presents the analytical framework of this study, drawing on relevant prior studies. Section 3 introduces the data used in this analysis. Section 4 analyzes the backgrounds underlying IIACR team formation, and Section 5 examines the relationship between these backgrounds and team performance. Finally, Section 6 summarizes the findings and discusses their implications.

2. Prior Studies and Analytical Perspective of This Study

2.1 Building Connections and Forming Teams Across Distances

International collaborative research faces both geographical and cultural distances. Geographical distance causes time differences and increases travel costs, leading to reduced communication frequency and diminished monitoring capabilities. Cultural distance signifies differences in shared perspectives, thoughts, feelings, and behaviors among national groups, which often become a source of conflict (Ou, Varriale, and Tsui 2022). Industry-academia collaborative research faces institutional distance (Sauermann and Stephan 2010; Crescenzi, Filippetti, and Iammarino 2017; Subramanian, Lim, and Soh 2013; Lam 2007; Bruneel, D'Este and Salter 2010), which refers to institutional differences in values, norms of conduct, and laws and rules (Boschma 2005). Specifically, industry conducts R&D within team structures that provide individuals with less freedom to attain practical goals aligned with corporate strategy, and is cautious about disclosing results to gain benefits from the exclusive use of knowledge. Conversely, academia conducts research primarily to develop knowledge within the cognitive context of specific disciplines. Because individual creativity is crucial to this creation, academic researchers are granted greater autonomy. Additionally, they value recognition from peer researchers based on discovery priority, which results in the active publication of research outcomes.

Consequently, it is difficult to find suitable partners and form industry-academia collaborative research teams. Therefore, as mentioned in the previous section, intermediary organizations support networking. Researchers also form collaborative research teams without assistance from intermediary organizations. They form teams with those already known to them and with whom effective communication channels have already been established. Barnes, Pashby, and Gibbons (2002) argued that since developing the trust necessary for collaborative research requires considerable time, it is justified to collaborate with former colleagues or with those who share collaborative experiences. Freeman, Ganguli, and Murciano-Goroff (2014) found that the most common first encounter among international co-authors was while working at the same institution. Bercovitz and Feldman (2011) noted that individuals who have worked together in the past tended to form teams, even when they were geographically distant. The relationship between faculty advisors and students/post-docs also provides opportunities for initial encounters with co-authors in international collaborative research (Freeman, Ganguli, and Murciano-Goroff 2014; Melkers and Kiopa 2010). Regarding industry-academia collaboration, Murakami (2025a), using survey data on knowledge exchange networks between corporate and university researchers in Japan, revealed that friendships and mentor-mentee relationships formed during school days serve as catalysts for building industry-academia networks. However, the same survey also indicated that encounters between corporate and university researchers at academic conferences are even more frequent. Therefore, academic conferences provide critical opportunities for the formation of networks and collaborative research teams among researchers without personal connections.

Regarding IIACR, prior studies have analyzed the role of overseas subsidiaries of multinational corporations (MNCs). The overseas R&D units of MNCs play an increasingly crucial role in knowledge search and creation. They are expected to link to local science networks in the host country by leveraging their spatial proximity to local universities (Belderbos et al 2021). Corsi, Fu, and Külzer-Sacilotto (2021) highlighted that when MNCs engage in international industry-academia collaborations, the local collaboration managers at the overseas base play a boundary-spanning role across cultural differences between the home and host countries. This is due to their dual embeddedness: being a member of a foreign organization while being integrated into the local context. Furthermore, Fassio, Geua, and Rossi (2023) noted differences between corporate and academic researchers in terms of team formation: the former relied on subsidiary networks of MNCs, while the latter relied on personal international linkages.

As described above, several factors contribute to team formation across distances. The present study analyzes how these factors interact to form IIACR teams.

2.2 The Impact of Team Formation Background on Team Performance

Nishimura et al. (2022) examined collaboration between university and industry researchers. Based on a large-scale survey of co-inventors comprising university scientists and industry researchers, they found that researchers seeking partners with high capabilities and a good fit with the project used their own contacts, while the support units for university-industry research collaboration were used more when geographical proximity was more important than the capabilities of research partners. They also found that projects with partners selected based on research capability and good fit demonstrated high performance, as measured by the indicators of patents, papers, and business commercialization.

Murakami (2025b) examined the effectiveness of connection support in forming domestic industry-academia collaborative research teams in Japan. Teams formed through the introductions of research partners from national agencies, universities, or firms demonstrated significantly higher citation counts for their papers than those formed without such support. Furthermore, Murakami (2025a) demonstrated that the tie strength of knowledge exchange networks between corporate and university researchers varies depending on the triggers of tie formation, such as “university acquaintances,” “acquaintances from academic conferences,” “introduction by intermediary organizations,” and so on.

Trust is what connects the formation background and performance of teams. There are two types of trust: cognitive and affective (McAllister 1995). The former involves trusting other members' competence and responsibility, whereas the latter is based on emotional bonds with other members, fostering reciprocal feelings, and consideration of others’ well-being. Trust promotes intellectual exchange by fostering the belief that others will reciprocate (Nahapiet and Ghoshal 1998). Previous research indicates that trust lowers barriers to industry-academia collaboration. Bruneel, D’Este and Salter (2010) identified orientation- and transaction-related barriers in university-industry collaborations. A large-scale survey of United Kingdom firms showed that greater levels of trust reduced both types of barriers. Albats, Bogers, and Podmetina (2020), based on interviews with 10 firms in Europe and the United States (US), and Galán-Muros and Plewa (2016), based on a questionnaire survey of European universities, argued that trust and the availability of complementary resources are the drivers of industry-academia collaboration.

Based on the abovementioned research, the formation backgrounds of IIACR teams can influence trust among members and, consequently, team performance. For example, Nishimura et al. (2022), as noted above, found that the criteria for partner selection and team performance differ depending on whether researchers use their own networks or whether a university-industry research collaboration support unit is involved in the selection process. Their conclusion is that teams perform better when formed through researchers’ networks based on cognitive trust in partners’ capabilities. Additionally, Murakami (2025a) found that ties within knowledge exchange networks between corporate and university researchers formed through intermediary organizations tend not to last, suggesting that trust fails to develop when support is accepted from the intermediary organization. Therefore, there may be difference in the performance of IIACR teams depending on whether teams are formed with the support of intermediary organizations or whether researchers voluntarily form teams on their own. The remaining sections of this study identify team formation backgrounds and analyze their impact on teams’ research outcomes.

3. Data

This study treats the co-authors of a paper as a team. First, IIACR teams were identified using the Science Citation Index Expanded database from Web of Science, which covers papers in the fields of science, medicine, and engineering. The sample of this study comprised teams with at least one Japanese and one German or American researcher that had published papers between 2017 and 2020. If the Japanese researcher was affiliated with a firm (university), then the German or American counterparts was required to be from a university (firm). Teams involving both Japanese corporate and university researchers were not excluded. The sample also included teams with researchers from countries other than the US and Germany. However, teams that included both American and German researchers were excluded. Additionally, although papers with more than 100 authors are not rare, members of such a large team may not know each other. Therefore, the sample was limited to papers with up to 20 authors.

Japan is one of the world’s leading nations in science and technology, as evidenced by R&D expenditures and the number of researchers, patents, and papers published (National Institute of Science and Technology Policy 2025). However, owing to its geographical features as an island nation, it has fewer international co-authored papers than its Western counterparts (National Institute of Science and Technology Policy 2025). Therefore,

the barrier level to establishing connections for IIACR teams seems to be high, which is why Japan was selected as the subject of this empirical study. According to Suzuki and Nagata (2015), the US and Germany were the most frequent partners in Japan's IIACR. This is the primary reason for limiting the partner countries to these two nations.

The survey was conducted from January to March 2024 (first phase) and from October to December 2024 (second phase) to collect information on the backgrounds underlying team formation. Identical questionaries in English were administered in both phases. In the first phase, 1,026 corresponding authors who had published papers in 2017 or 2018 and met the abovementioned search criteria, were requested to cooperate. The request explicitly stated that responses should come from the person most familiar with the team, not necessarily the corresponding author. This yielded 98 valid responses, resulting in a response rate of 9.6%. The second phase requested the same cooperation from the corresponding authors of 887 teams that met the same criteria, had published papers in 2019 or 2020, and did not overlap with the first phase sample; this yielded 62 valid responses (response rate: 7.0%). The low response rates are a limitation of this study; this is because the international survey was conducted without the support of public or private organizations. Performance data may be biased upward because teams that performed relatively well were more likely to cooperate.

For all 160 teams, information on team size and authors' national composition was collected from Web of Science. The bibliographic database also provides citation count information, which served as the performance indicator used in this study. Because citation counts can increase daily, this study used the number of citations recorded as of April 13, 2024, and December 27, 2024, for the first and second phases, respectively.

The survey asked the participants about 11 items (listed in Table 1) regarding the backgrounds of forming IIACR teams, and asked them to rate the applicability of each item on a five-point scale (1= "does not apply at all," 2= "does not apply much," 3= "applies somewhat," 4= "applies," and 5= "not sure"). This study identified the item(s) receiving the highest rating as the formation background factor(s) of an IIACR team, but only if that rating was 3 or 4. Ratings of 1 and 2 were excluded as they indicate the item did not apply, and a rating of 5 ("not sure") was treated as a non-response. Consequently, 151 teams provided information on the team formation. Notably, some teams had multiple background factors.

Table 1: Formation background factors of IIACR teams

No.	Items	Abbreviation	Ratio (%)
1	The team members met at international conferences.	Conference	38.8
2	The team members met at an international technology fair.	Tech-fair	2.5
3	The team was set up by an Industry-University Cooperation Office.	Office	6.9
4	An overseas university joined an existing domestic industry-academia collaboration team.	Add-univ	18.8
5	An overseas firm joined an existing international research collaboration among universities.	Add-firm	16.3
6	Based on the research objectives, the most suitable members were selected from researcher networks.	Best-team	48.1
7	An overseas subsidiary of a company formed a team consisting of its parent company in the home country and overseas universities.	Subsidiary	9.4
8	An expatriate researcher brought together researchers from their home and host countries.	Expatriate	15.0
9	Researchers from overseas companies or universities gathered at a university laboratory for a limited period (visiting researchers, fellows, postdoctoral fellows, etc.).	Univ-lab	28.7
10	Overseas researchers who were already part of the team continued to collaborate with researchers in the host country after returning to their home country.	Returnee	26.3
11	The research was conducted in the past with almost the same members and worked well.	Repetition	33.8

Note: Some teams did not respond to questions regarding backgrounds underlying team formation, but the percentage values in the table represent the proportion (%) of teams that cited each item out of the 160 valid responses.

4. Backgrounds of Formation of IIACR Teams

Table 1 shows the percentage of teams selecting each background item. Because some teams cited multiple items, the total percentage exceeded 100%. As shown in Table 1, the most common response was "Based on the research objectives, the most suitable members were selected from researcher networks." Approximately half the teams held this perspective. This was followed by responses indicating that teams were formed by researchers who met at international conferences (38.8%). New variables were created by assigning a value of one to teams that selected each item and zero to those that did not. Pearson's correlation coefficients between these variables were calculated, and only significant relationships at the 5% level or lower are illustrated in Figure 1. Because "repetition" did not show a significant correlation with any of the other 10 factors, it is not included in Figure 1.

Figure 1 reveals several patterns of IIACR team formation. First, as shown on the left side, IIACR teams are formed when corporate and university researchers who met at international conferences, along with postdocs gathered under professors, conduct collaborative research in university laboratories. Even after team members return to their home countries, continuing collaborative research contributes to IIACR. Second, in cases where corporate researchers join academic teams originally engaged in international collaborative research (Add-firm), or where researchers from overseas universities join teams originally involved in domestic industry-academia collaboration (Add-univ), the overseas subsidiaries of MNCs and the industry-academia liaison offices at universities closely cooperate to support these connections. Researchers who met at international conferences also join such teams and contribute to these two cases. Third, expatriate researchers connect their home and host countries by collaborating with overseas subsidiaries and assembling the best team members from researcher networks. Even after returning home, they continue collaboration with researchers from the host country and contribute to IIACR.

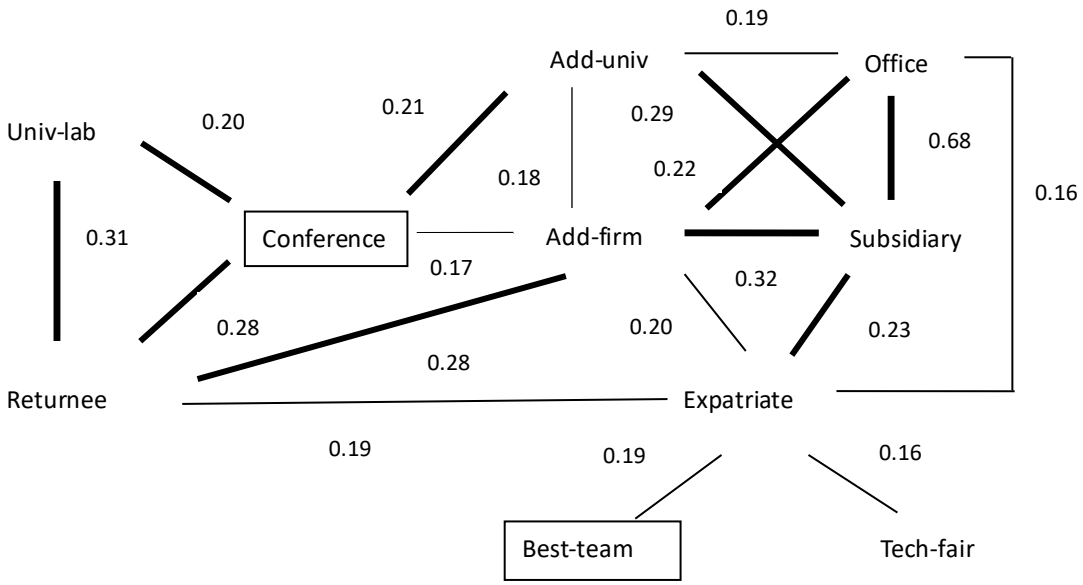

Figure 1: Correlations among background factors of forming IIACR teams

Note: 1. The values in the figure are Pearson's correlation coefficients.

2. The background factors enclosed in squares are those with high ratios (> 30%) in Table 1.

3. The thickness of the lines corresponds to the magnitude of the correlation coefficient.

Figure 2 shows a dendrogram generated based on a hierarchical cluster analysis, employing Ward's method, of the 11 items in Table 1. The horizontal axis in Figure 2 shows the coefficients; a higher value represents lower similarity. According to Figure 2, two main clusters are observed: the first consists of Office, Subsidiary, Tech-fair, Expatriate, Add-firm, and Add-univ, and the second consists of Univ-lab, Returnee, Conference, Repetition,

and Best-team. The first cluster concerns the intervention of organizations. Expatriates are usually employees of MNCs and tend to act in accordance with the organization's policies. Therefore, this background factor can also be considered an organizational intervention. The second cluster concerns the backgrounds related to the initiatives of individual researchers. Therefore, this study categorized the background factors into the organization-intervention and researcher-initiative types. We classify teams as "organization-intervention type" if any item from the first cluster is selected, while teams are considered "researcher-initiative type" if any item from the second cluster is selected.

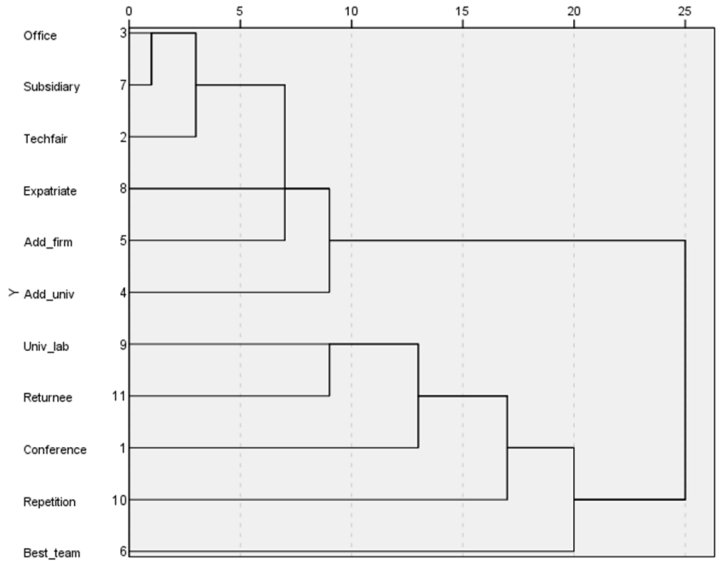

Figure 2: Dendrogram of background factors of forming IIACR teams

5. Differences in Team Performance Based on the Background Underlying Team Formation

As mentioned in Section 2, previous research indicates that developing the trust is necessary for collaborative research. Therefore, when classifying team formation backgrounds into the abovementioned two types, researcher-initiative-type teams such as teams formed through spontaneous agreement among researchers, meeting at international conferences, gathering in a laboratory for a certain period, or engaging in repeated collaborative research are likely to perform better than teams temporarily formed with organizational intervention because the former are likely to be based on researchers' strong mutual trust. Consequently, the following hypothesis is proposed:

Hypothesis: Researcher-initiated teams perform better than organization-intervention teams.

This study employed a Poisson regression analysis to test this hypothesis. Poisson regression analysis is a method to model count data, employing the Poisson distribution which is effective for describing the number of events occurring within a specific time period. The dependent variable in this study is citation counts of papers, which makes it suitable for Poisson regression analysis. However, citation counts are influenced by the citation period which varies depending on the publication date of the paper. Thus, the citation counts per day were employed in this study. For the first phase, the citation period was defined as the number of days from the publication date to April 13, 2024. In the second phase, it was defined as the number of days from the publication date to December 27, 2024. In a Poisson regression model, the dependent variable must be non-negative integer values. Therefore, the number of citations was divided by the citation period, multiplied by 10,000, and then rounded to the nearest whole number to convert it into an integer value.

The independent variables are listed in Table 2. The focus variable in this study was "Researcher." If its coefficient was significantly positive, the hypothesis could be considered supported after controlling for team size, national diversity, and field of study. The fields of study were divided into five categories, with medicine/dentistry/pharmacy serving as the reference category. The sample includes teams with both researcher initiative and organization-intervention factors. Therefore, the effect of the Researcher variable may include the influence of organization-intervention factors. To remove this influence, I created the R_alone variable, which indicates that a team has only researcher initiative factors.

Table 2: Definitions of variables and basic statistics

Variables	Definition	Minimum	Maximum	Average	Standard deviation
NC	Periodically adjusted citations (integer value)	4	1583	161.20	244.79
Size	Number of team members	2	20	8.90	4.07
Diversity	Number of team members' countries of residence	2	12	2.75	1.38
MPC	Research field: Mathematics/Physics/ Chemistry = 1, Others = 0	0	1	0.22	0.42
EC	Engineering/Computer Science = 1, Others = 0	0	1	0.26	0.44
BAE	Biology/Agriculture/Environmental Science = 1, Others = 0	0	1	0.17	0.38
ID	Interdisciplinary=1, Others=0	0	1	0.08	0.27
Researcher	Researcher-initiative type=1, Others=0	0	1	0.93	0.25
R_alone	Researcher-initiative factors alone=1, Others=0	0	1	0.57	0.50

Note: N=138

Table 2 also presents the basic statistics; 93% of the teams have at least one researcher initiative factor. The proportion of teams with only researcher initiative factors decreases to 57%. Because of space constraints, the correlation coefficient matrix is omitted. The relatively high correlations were 0.38 between the Size and Diversity variables, and -0.32 between the MPC and EC variables; all others were below 0.30.

Table 3 shows the results of a Poisson regression analysis employing data from teams that responded to all variables in Table 2. The coefficients of the Researcher and R_alone variables were significantly positive at the 1% level. Therefore, the hypothesis of this study was supported. Because the coefficient for the R_alone variable is larger than that for the Researcher variable, teams formed solely by researcher initiative factors, without the influence of organization-intervention factors, performed better. Furthermore, the coefficients of the Size and Diversity variables were also significantly positive. Within the range of 20 for the former and 12 for the latter, higher values indicated better performance. In other words, the larger the team and/or the more diverse the countries, the higher the team performance

Table 3: Estimation results

Variables	Model 1 Coefficient (S.E.)	Model 2 Coefficient (S.E.)
Constant	4.470 (0.0364) **	4.420 (0.0242) **
Size	0.021 (0.0019) **	0.022 (0.0019) **
Diversity	0.117 (0.0040) **	0.105 (0.0040) **
MPC	-0.464 (0.0224) **	-0.532 (0.0225) **
EC	-0.068 (0.0196) **	-0.065 (0.0196) **
BAE	0.034 (0.0205)	0.030 (0.0205)
ID	0.374 (0.0228) **	0.320 (0.0229) **
Researcher	0.139 (0.0295) **	
R_alone		0.372 (0.0144) **
LogL	-14168.9	-13834.3
Observations	138	138

Note: **p<0.01

6. Conclusion

This study analyzes team formation in IIACR and identifies distinct differences in team performance based on team formation patterns. Regarding IIACR, geographical and institutional distances act as barriers to

connections and team formation among researchers, but they generate new knowledge flows and innovative connections of knowledge. Although there were several team formation patterns, the cluster analysis reveals two primary patterns. The first involves the formation of IIACR teams mediated by MNCs' overseas subsidiaries and expatriates or by industry-university liaison offices. In such cases, overseas subsidiaries and liaison offices often cooperate. The second pattern involves the formation of IIACR teams through the initiative of researchers. This includes cases where researchers meeting at international conferences or those gathering at a university laboratory for a certain period voluntarily form teams, or when members of such teams repeatedly engage in collaborative research. We designate the former and latter patterns as "organization-intervention type" and "researcher-initiative type," respectively. Results from a Poisson regression analysis measuring team performance by paper citation count revealed that research outcomes were higher for the latter than for the former type. Galán-Muros and Plewa (2016) and Albats, Bogers, and Podmetina (2020) cite complementary resources (funding, human resources, knowledge, equipment, etc.) and relationships (trust in partners, shared goals, past connections, etc.) as two drivers of industry-academia collaboration. Teams assembled from researchers' initiatives seem to be well aware of and trust in other team members' complementary knowledge. This enables higher performance than teams that are temporarily assembled from organizational perspectives.

The present study's findings have several practical implications. First, international conferences serve as crucial venues for corporate and university researchers to gather across borders, providing opportunities for networking and team formation. Therefore, policies supporting the hosting international conferences, along with corporate and university initiatives encouraging and assisting the participation of researchers in such conferences, contribute to the formation and successful outcomes of IIACR teams. Second, policies supporting the establishment of industry-university cooperation offices are effective not only for domestic industry-academia collaborative research but also for initiating IIACR. When supporting the formation of IIACR teams through collaboration between industry-university cooperation offices and MNCs' overseas subsidiaries, it is advisable to leverage existing networks among researchers built on trust to enhance research performance.

This study has some limitations. First, it only analyzed IIACR teams comprising researchers from Japan, the US, and Germany. Future research should investigate whether similar results hold for IIACR teams comprising researchers from European countries alone, with lower geographical/cultural distances, or for IIACR teams involving researchers from countries with varying levels of scientific and technological development. Second, while this study examined team performance from the perspective of their formation background, team management may also influence the ability to overcome geographical and institutional distances and may affect performance. Incorporating an analysis of this aspect remains a priority for future studies.

Acknowledgements

I gratefully acknowledge financial support from the Japan Society for the Promotion of Science Grants-in-Aid for Scientific Research (Grant Number: JP21K01729).

Ethics Declaration: I declare that ethical clearance was not required for the research presented herein.

AI Declaration: I declare that I have never used an AI tool in writing this paper.

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