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University-Industry Collaboration and Innovation Performance: Evidence from the University of Surabaya in Indonesia

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Abstract. *The Indonesian government, through the Ministry of Education, Culture, Research, and Technology (Kemdikbudristek) has introduced the Matching Fund (MF) program. MF is a concrete form of government support and intervention to create collaboration and strategic synergy between higher education institutions (universities) and industry. This study aims to investigate and analyze various forms of collaboration and interaction between universities and industry and their impact on innovation performance in the Matching Fund (MF) program. This study uses an interpretive qualitative methodology with eight (8) case studies of the MF program at the University of Surabaya, Indonesia, during the period 2021 to 2023. The results of the study show that the forms of interaction that occur are very diverse, ranging from informal to very formal interactions. This study also shows that the number and form of interactions are not influenced by the duration of the collaboration. The variety of forms of interaction is more determined by the quality of the company and university leaders, good relationships and mutual trust between the two parties, good relationships, coordination, and communication between the persons in charge (PICs) of the two parties. Furthermore, the results of the study show that the MF program provides direct innovation outcome (DIO) and indirect innovation outcome (IIO) results for companies. On the other hand, the MF university-industry collaboration program also provides positive results for the universities in terms of DIO and IIO, but not all university-industry collaboration projects provide maximum results for academic innovation (AI). The duration of cooperation, mutual trust, and good coordination and communication between the persons in charge (PICs) of the two parties all have a greater influence on AI.*

Keywords: *University, Industry, Collaboration, Matching Fund, and Innovation Performance*

1. Introduction

These days, university-industry collaboration (UIC) is increasing and developing because it is seen as the right way to improve innovation performance through the exchange of knowledge and technology (O'Dwyer et al., 2023). This is supported by various previous studies that have been conducted although mostly in developed countries (Kafouros et al., 2015). Information provided by research on UIC in developing countries shows that UIC it is often difficult to achieve the goals of university-industry collaboration that are expected by each party, especially the aspect of balancing performance and benefits obtained (Fernandes et al., 2023; Lin, 2017). There are various factors that cause this. The differences in nature, culture, expectations, needs, and goals of two very different institutions are often the main obstacles (Kleiner-Schaefer & Schaefer, 2022). Song et al. (2022) state that, to overcome the obstacles faced by UIC, several countries have tried various schemes. One of them is to encourage government involvement in supporting the success of collaborations between universities and industry and maintaining a balance in the innovation performance of both parties.

In 2021, the Indonesian Government, through the Ministry of Education, Culture, Research, and Technology (Kemdikbudristek), introduced the Matching

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Fund (MF) program. MF is a real form of government support and intervention for the creation of collaboration and strategic synergy between higher education personnel (universities) and industry. This program has been designed to increase the benefits and relevance while aligning the development of science and technology that occurs in universities so that it is in line with, and meets, the needs of industry or addresses its problems. The MF program involves financial support from the government that is matched by industry on a balanced 1-to-1 basis to support and encourage cooperation between university personnel and industry initiated through the Kedaireka platform run by Kemdikbudristek. This platform is expected to be a center for meetings and communication between creators in universities and the industrial world. Kedaireka's MF program has been running from 2021 to the present day and is open to all universities in Indonesia.

This study aims to investigate and analyze various forms of collaboration and interaction between universities and industry and their impact on innovation performance in eight (8) case studies of the Matching Fund UIC program at the University of Surabaya, Indonesia, during the period 2021 to 2023.

Studies on UIC and its impact on innovation performance have been previously conducted by several researchers. These studies have shown how UIC can significantly improve the innovation performance and competitiveness of companies (Freitas et al., 2013; Hou et al., 2019; Maier et al., 2024; Rantala & Ukko, 2018; Wang, 2023). Meanwhile, research related to the impact of UIC on university innovation performance is still relatively scarce and has tended to use limited measures of technology innovation performance and direct outcomes, such as research publications, number of patents, number of business incubators (Tseng et al., 2020), the experience of university experts, entrepreneurial climate, and the number of new business ideas at universities (Ćudić et al., 2022). In fact, according to Clauss et al. (2024), one way to preserve the sustainability and success of UIC is to maintain a balance between the innovation performances of both industry and universities. This study intends to fill the research gap, in particular by enriching the study of the impact of UIC on university innovation performance by using more complete innovation performance indicators. This study will examine various forms of UIC collaboration and interaction and their impact on the university-industry balance in terms of innovation performance. The novelty of this study is that it analyzes various types of university and industry collaboration by adopting and modifying aspects of UIC forms and formations in a comprehensive way (Ankrah & Omar, 2015), using more complete innovation performance indicators that take into account aspects of academic innovation and direct and indirect innovation outcomes; it also focuses more on obtaining input from parties actively involved in the UIC process, both from university personnel and persons in charge from industry. There are two research questions raised in this study, namely:

RQ1: What are the forms and formations of UIC interactions that occur between individual academic staff and industry practitioners?

RQ2: What is innovation performance in terms of the outputs and outcomes of UIC from the perspective of each party?

This study contributes to the literature review by enriching its understanding of the various forms and formations of UIC related to innovation performance while considering a balanced perspective between universities and industry; the impact of UIC on innovation performance in the short and long term; the impact of UIC on academic innovation; and obtaining a complete picture of how the UIC process involves government intervention in developing countries.

2. Literature Review/ Hypotheses Development

The literature defines university-industry collaboration (UIC) in general terminology as a form of cooperation that provides significant innovation performance benefits (Cohen et al., 2024). On the other hand, Oliver et al. (2020) state that UIC is a process of interaction between university scientists and industry practitioners who work together to conduct research and transform research results into innovations that can be applied to society and commercialized in potential markets. Today, in the era of the knowledge economy and global innovation economy, UIC is becoming very important as it develops rapidly (Lin, 2017). For industry, increasingly rapid technological changes, increasingly short product life cycles, increasingly tight global competition, increasingly expensive innovation costs, ever more efficient R&D activities, and easy access to new talent and experts are the main motivations for collaboration (Ankrah & Omar, 2015). Meanwhile, for universities, increasingly rapid changes in knowledge, the need for new knowledge, the demand for innovation and the downstreaming of research results, access to funding for research activities, financial challenges, and high management costs require universities to collaborate with industry (Evans et al., 2023).

Collaboration between universities and industry can be carried out on their own initiative, either by individuals in the universities and industry informally or through formal bilateral cooperation between the institutions. In addition, UIC can often occur because it is supported by state intervention. The support of a country's government is generally because UIC is considered important for improving regional and national innovation systems (Philpott et al., 2011) and encouraging national economic development (Rajalo & Vadi, 2017). In the context of UIC implementation in developing countries, the challenges faced are very diverse when compared to developed countries. These challenges include research and development activities in industry that are slower and not ideal; research facilities that are inadequate; not enough industries that are based on advanced technology (Malik & Wickramasinghe, 2015); a lack of mutual understanding and trust between universities and industry; frequent changes in industrial policies and inadequate university governance (B. Y. Moeliodihardjo et al., 2012); and generally the orientation of universities which is more toward being institutions of teaching and fundamental research (T. Mgonja, 2017). The various problems and challenges faced by UIC in developing countries mean that the governments continue to be the main drivers of university-industry collaboration (Jonbekova et al., 2025).

2.1 The Forms and Formation of UIC

The forms and formations of UIC vary greatly depending on the extent to which the parties are interconnected and collaborate as well as what the motivations are for collaborating. According to Evans et al. (2023), UIC interactions are relatively broad, and each researcher often presents a different typology or taxonomy. Other forms and formations of UIC that are widely practiced and discussed in the literature include joint ventures, consortia, alliances between universities and industry (Barringer & Harrison, 2000), collaborative and joint research (Kamal et al., 2024), licensing of university patents by companies (Evans et al., 2023), sabbatical leave for university staff to work in an industrial setting (Canhoto et al., 2016), training and consulting programs for companies by university experts (Rossoni et al., 2024), and practitioner lecture programs and other learning support such as internships for students by industry (Rossoni et al., 2024). In a study of university-industry collaboration as a driver in digital transformation, Evans et al. (2023) use five (5) types of UIC, namely research, collaboration involving students, innovation and commercialization, teaching and learning, and sharing facilities. With a more structured approach, Jones & de Zubielqui (2017) state that there are two types of interactions between universities and industry, namely generic links (such as human

resource transfer/mobility, scientific publication, IP, informal sources of ideas) and relational links (such as research services and research partnerships). In the context of UIC implementation in developing countries, there are several variants of collaboration involving the government, such as University-Industry Lingakes (UIL), University-Industry Partnership (UIP), University-Industry Alliance (UIA), and University-Industry Relationship (UIR), which are more focused on encouraging research cooperation (T. Mgonja, 2017). Meanwhile, Ankrah & Omar (2015) propose a framework that is relatively broad in scope and is considered suitable for adoption in this study. The framework consists of six main categories, namely informal personal relationships, formal personal relationships, relationships through third parties, targeted formal agreements, non-targeted formal agreements, and relationships with focused structures. The six groups of relationships and collaborations above indicate an increasing level of organizational involvement, which can be briefly analyzed in three dimensions, namely (a) involvement of resources from each party, (b) length of agreement, and (c) level of formalization of cooperation. In the first dimension, there is no involvement of university organizational resources if the company's contact with the university is with academics as individuals without any agreement signed with the university. Beyond that, university resource involvement increases from formal personal relationships to the category of focused structures, where the entire university is involved in a specific structure to collaborate with industry.

As for the second dimension, the duration of agreements between universities and companies, it can vary from short-term (although renewable) in the case of formal personal relationships, to long-term in the case of specific or focused structures. The exception is in the case of relationships between universities and industries organized by third parties, which can have a long duration if the relationship turns into a more stable one. In the case of formal personal relationships—the third dimension—the formalization of agreements is low or nonexistent. In formal personal relationships and through third parties, formalization of agreements may or may not exist. In the other groups, the relationships are much more formal.

2.2 UIC and Innovation Performance

The UIC process has been recognized as an appropriate way to improve innovation performance, both for industry and universities, through the exchange of knowledge, resources, and technology (O'Dwyer et al., 2023). Several previous studies have shown how UIC can significantly improve innovation performance and company competitiveness (Hou et al., 2019; Maier et al., 2024; Rantala & Ukko, 2018; Wang, 2023). Hou et al. (2019) state that UIC has been proven to increase innovation efficiency for industry. Meanwhile, Lin (2017) states that the UIC process has led to industry having better innovation capabilities because it is able to develop something new and useful in the future. On the other hand, Clauss et al. (2024) state that a good relationship between universities and industry will trigger entrepreneurial activities and produce many results from innovation. The same thing has been stated by Baleeiro Passos et al. (2023), who show that university-industry interaction has become an important factor in improving innovation performance through knowledge exchange. Meanwhile, from the university's perspective, collaboration with industry has had a major impact on improving the innovation performance and productivity of academic research in the long term (Cohen et al., 2024). In addition, Huang & Chen (2017) have demonstrated that UIC with a formal mechanism has a positive influence on academic innovation performance. The same thing has been stated by Tseng et al. (2020) who show that UIC has an impact on university innovation performance, especially technological innovation performance. With a more comprehensive approach, Alpaydın & Fitjar (2024) have succeeded in demonstrating that UIC with a more formal mechanism encourages increased innovation

performance, both in industry and in universities. However, several previous studies, especially in developing countries, have shown that university and industry collaboration does not always achieve the goals expected by each party (Kafouros et al., 2015). In addition to the diverse challenges faced by UICs in developing countries, previous research has several limitations, especially in measuring the impact of UICs. These include them being more oriented toward short-term impacts, focusing on outputs rather than outcomes, and being more likely to measure the impact of UICs on innovation performance on the industry side. Measuring the impact of UICs on universities' innovation performance is relatively limited and tends to use limited measures of technological innovation performance and direct outcomes (Tseng et al., 2020; Ćudić et al., 2022).

Research on UICs in developing countries shows that the results of collaboration between universities and industry do not always have direct outcomes that can be felt immediately in the short term (industry orientation), but there can also be indirect outcomes that are felt after the collaboration has been longstanding (university orientation) (Saad et al., 2017). There are four forms of indirect outcomes that can potentially be obtained from the results of UIC (Alpaydın & Fitjar, 2024), namely (1) cognitive proximity which is a closeness due to the similarity of the knowledge base and expertise of the collaboration actors, so it is hoped that it will make it easier for partners to understand each other; (2) organizational proximity is closeness due to the relationship that is shared in the organizational setting, so it is expected to facilitate the interaction process through hierarchy or joint control over the collaboration carried out; (3) institutional proximity is closeness due to the similarity of norms and values, so it is hoped that a collaboration can continue in the long term; and (4) social proximity is closeness due to the existence of socially embedded relationships between actors at the micro level, so it is hoped that trust will arise based on friendship, kinship, and experience which are very influential in sharing information in the collaboration process. Overall, this proximity will benefit both universities and industries because it will be the foundation for the smoothness and success of various collaborations in the future. On the other hand (Lin, 2017), says that such closeness due to long and positive interactions between universities and industries will encourage the emergence of academic innovation in universities, such as curriculum innovation, innovation in learning methods, new experiences for lecturers interacting closely with industry, and the fostering of an entrepreneurial climate on the campuses that will have an overall impact on innovation performance the universities.

3. Methodology

This study employs an interpretive qualitative methodology using eight case studies of UIC MF projects at the University of Surabaya (Ubaya), Indonesia. Case study methodology has become more common in UIC studies in recent years because it can help explain and understand the multidimensional and complex processes of the issues (Villani et al., 2017).

The research procedure begins with determining the research variables and developing research instruments. The research model and framework developed in this study are an integration of various previous research models. The form and formation of UIC will be analyzed using the framework proposed by Ankrah & Omar (2015). The form and formation of UIC consist of six main categories, namely (a) informal personal relationships; (b) formal personal relationships; (c) relationships through third parties; (d) targeted formal agreements; (e) non-targeted formal agreements; and (f) focused structure creation. Meanwhile, the performance of UIC process innovation for universities and industry is carried out separately. The innovation performance of the company is

measured by adopting and modifying the model proposed by Alpaydın & Fitjar (2024), namely direct innovation outcomes (DIO), such as product innovation, process innovation, organizational innovation, and marketing innovation, and indirect innovation outcomes (IIO), such as cognitive proximity, organizational proximity, institutional proximity, and social proximity. Meanwhile, the innovation performance of the university is measured by integrating and modifying the model proposed by Alpaydın & Fitjar (2024), namely DIO, such as the number of publications, number of patents and intellectual property rights (IPRs), number of innovation ideas, number of business incubators, and commercialization of research results, and then IIO, such as cognitive proximity, organizational proximity, institutional proximity, and social proximity, and academic innovation (AI) (Lin, 2017), such as curriculum innovation, learning method innovation, new experiences of lecturers and students, and campus entrepreneurial climate. Based on the research variables above, the research model framework is compiled as follows (see Figure 1).

The next step is to determine the research case study. Eight (8) case studies from the MF project were selected based on the following criteria: (1) the MF project between the University of Surabaya (Ubaya) and industrial partners representing large industries; (2) MF projects represent, as much as possible, various faculties and fields of study programs at Ubaya; and (3) collaborative projects between the University of Surabaya and industry in the period 2021 to 2023. The following is a list of case studies that will be used in this study (see Table 1).

The validation process of the research variables was carried out using focus group discussions (FGDs) involving all parties who were the objects of the study, such as representatives of the industry and universities, university personnel, and industry persons in charge (PICs) who were directly involved in UIC activities. If the research variables could be understood and accepted, the data collection process would be continued. However, if not, it would return to the previous process. The data collection process was carried out using the deep interview method with all related parties. The interview process was conducted by sending a list of questions to all parties to be interviewed. This was done so that the list of questions could be studied and answers prepared in advance prior to the face-to-face interviews. To minimize potential bias, all interview results were discussed by the research team and all the interviewees.

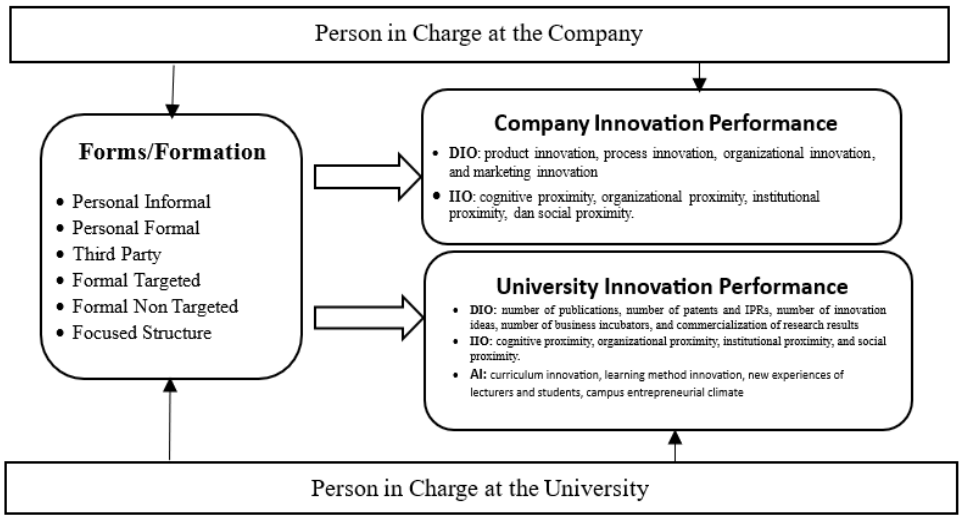

Figure 1.
Research Model Framework

Table 1.
List of Case Studies

Case Studies	Industrial Sector	Project Title	Year
CS-1	Pharmaceuticals	Extraction and formulation of extract of ginseng powder	2021
CS-2	Bicycle	Development of roadster bicycle startup as a green delivery service	2021
CS-3	Food	Development of high-fiber functional food products based on VCO	2021
CS-4	Health	Development of Probiotics for prevention and treatment of COVID-19	2021
CS-5	Textiles	Development of quality safety hand gloves	2021
CS-6	Steel & Energy	Development of training and certification of PLTS and solarpreneur systems	2021
CS-7	Pharmaceuticals	Transformation of herbal databases based on artificial intelligence	2022
CS-8	IT Services	Interactive tele-assessment of psychology based on artificial intelligence	2023

4. Findings and Discussion

The first results of this study will answer research question 1 (RQ1), concerning the forms of interaction and formation of UIC that occur between individual academics and industry practitioners (RQ1). The following tables present the results of the research on the forms of interaction between the academics at the University of Surabaya and the practitioners from the companies (see Table 2). In addition, the time and duration of the collaboration that has been established are also identified.

The results of this study show that the forms of interaction displayed are very diverse, ranging from informal to very formal ones. This can happen because several companies have had a fairly long duration of cooperation with Ubaya before participating in the MF program. The MF program itself is included in the category of formal targeted agreement collaborations with contract research activities, and patenting and licensing agreements (where the duration of cooperation is one year). All case studies must have at least this form of collaboration. In addition, all case study companies have also had a general agreement in the form of an MoU because it is a requirement to participate in the MF program. The data above show that there are three UICs that have achieved a more serious and very formal form of collaboration in the form of focused structures, namely the collaboration between Ubaya and PT. Bintang Toedjoe with the establishment of a university-industry research center (HanbangBio Lab), a collaboration between Ubaya and PT. Utomo Metal Work with the establishment of an innovation/incubation center (Solarpreneur training center), and collaboration between Ubaya and PT. Saka Farma with the establishment of a startup and incubation center (Jamoetik). The three focused structured collaborations are still running even though the MF project funding has ended. In addition, from the data above, it can also be seen that all UICs have a form of personal informal relationship collaboration. This shows that most UICs occur at the outset from direct and informal contacts between university experts and industry practitioners and some are facilitated by liaison offices at the university level (university leaders, the Ubaya innovation hub). The results of this study also show that the number and form of interactions are not influenced by the duration of the collaboration.

Table 2.
Length of Cooperation and Form of Interaction

Case Study	Length of cooperation (years)	Form of interaction					
		Personal informal relationship	Personal formal relationship	Third Party	Formal targeted agreements	Formal non-targeted agreement	Focused structures
CS-1	7	Individual consultancy, personal contact with academic staff	Student internships, students' involvement in industrial projects, hiring the graduate students	Institutional consultancy, collaboration through university liaison	Contract research, patenting and licensing agreement, cooperative research project, and joint curriculum development	General agreement for UIC (MoU), Industry supports R&D activities at universities in the form of equipment, technology and industry experts	Establishment of university-industry research center: Hanbang Bio Lab
CS-2	10	Information exchange forum	Student internships, students' involvement in industrial projects, hiring the graduate students, scholarships	Collaboration through university liaison	Contract research, patenting and licensing agreement	Industry supports R&D activities at universities in the form of equipment.	
CS-3	3	Personal contact with academic staff	Student internships, use of university lab facility		Contract research, patenting and licensing agreement	General agreement for UIC (MoU),	
CS-4	6	Personal contact with academic staff	Student internships, students' involvement in industrial projects, hiring the graduate students, use		Contract research, patenting and licensing agreement, cooperative research project,	General agreement for UIC (MoU), Endowed chairs and advisory boards at universities, Research	

Case Study	Length of cooperation (years)	Form of interaction					
		Personal informal relationship	Personal formal relationship	Third Party	Formal targeted agreements	Formal non-targeted agreement	Focused structures
			of university or industry facility		and joint curriculum development	grants (financial or equipment), either general or targeted to specific departments or academics	
CS-5	3	Personal contact with academic staff	Student internships, Thesis and dissertation guidance		Contract research, patenting and licensing agreement, Training programmes for employees	General agreement for UIC (MoU)	
CS-6	3	Information exchange forum, personal contact with academic staff, joint lectures	Student internships, students' involvement in industrial project, use of university or industry facility	Collaboration through university liaison, government agency involvement, industry associations act as intermediaries	Contract research, patenting and licensing agreement, Training programmes for employees	General agreement for UIC (MoU)	Establishment of innovation/incubation center: Solarpreneur training center
CS-7	3	Information exchange forum	Student internships, students' involvement in industrial project	Involving the Indonesian Artificial Intelligence Society and the Indonesian Herbal	Contract research, patenting and licensing agreement	General agreement for UIC (MoU), Industry supports R&D activities at universities in the form of equipment.	Establishment of startup and incubation center: Jamoetik

Case Study	Length of cooperation (years)	Form of interaction					
		Personal informal relationship	Personal formal relationship	Third Party	Formal targeted agreements	Formal non-targeted agreement	Focused structures
CS-8	2	Individual consultancy, personal contact with academic staff, joint lectures	Student internships, students' involvement in industrial projects	Medicine Association Collaboration through university liaison (Ubaya Innovation Hub)	Contract research, patenting and licensing agreement	General agreement for UIC (MoU)	

Based on the interview results, it was concluded that the variety of forms of interaction is more determined by the quality of the company and university leaders, good relationships, mutual trust between the two parties, and good coordination and communication between the PICs of the two parties. Of course, this conclusion only applies to the case at the UIC at the University of Surabaya involving several industries and is not necessarily applicable in general. However, this result is in accordance with several previous studies. Fernandes et al. (2023) stated that the critical success factors of UIC, specifically in R&D collaborations, are good leadership, effective communication, and mutual trust and respect. The role of university and industry leaders is very important in encouraging various forms of collaboration through the process of control and monitoring of the collaboration being carried out. University and industry leaders agree that they do not want to just sign a collaboration MoU where there is then no concrete action arising from the collaboration. In addition, this UIC is directly controlled and supervised strictly through scheduled monitoring and evaluation activities by the government project management team, meaning that all activities and programs that have been promised in the MF proposal must be implemented properly. Sjöö & Hellström (2019) said that UICs with a formal form—such as a UIC MF involving the government—will tend to achieve the targets of activities and programs being run. Pillay et al. (2014) said that collaboration that has a formal form of cooperation will have clear and realistic goals, meaning that collaborative projects can be carried out well and successfully, even though the duration of cooperation between the two parties has not been long.

The second research question is about what the innovation performances as outputs and outcomes of UIC are from the perspective of each party (RQ 2), and these can be displayed as follows (see Table 3 and Table 4):

Table 3.
Innovation Performance of Companies

Case Study	Companies' Innovation Performance	
	DIO	IIO
CS-1	Product innovation and ginseng cultivation development process with faster harvest time (Product not yet marketed but has been used by the company as raw material for one of the products).	Cognitive proximity: common knowledge base and expertise of collaboration actors Institutional proximity: there are common norms and values Social proximity: there is a social relationship between actors, trust arises based on friendship, kinship and experience
CS-2	Development of electric bicycles with various types, innovation of electric bicycle products with more affordable prices (in the form of prototypes not yet mass produced) Process innovation, delivery services using more environmentally friendly bicycles (Startup Onthel has been running on a small scale)	Cognitive proximity: common knowledge base and expertise of collaboration actors Institutional proximity: there are common norms and values. Social proximity: social relationship between actors at the micro level and there is trust based on friendship, kinship and experience between company owners and university and faculty leaders
CS-3	Process and product innovation in the development of high-fiber functional food products based on VCO (product prototypes are available but not yet produced).	Institutional proximity: there are common norms and values. Social proximity: trust based on friendship and familiarity between collaboration actors
CS-4	Probiotic product innovation. The product has undergone clinical trials and the product has been produced and marketed (spin-off and commercialization) and has generated adequate sales levels. Marketing innovation because it involves students in marketing	Cognitive proximity: there is a common knowledge base and expertise of collaboration actors Institutional proximity: there are common norms and values. Social proximity: there is a social relationship between actors at the micro level and there is trust based on friendship and collaboration experience so far.
CS-5	Innovation of new glove products but currently still at the prototype stage	Social proximity: there is a socially embedded relationship between actors at the micro level based on friendship because the company owner is an alumni.
CS-6	Organizational innovation because it has succeeded in creating an innovation center:	Cognitive proximity: common knowledge base and expertise of actors Organizational proximity: interaction process

Case Study	Companies' Innovation Performance	
	DIO	IIO
	solarpreneur training center in collaboration between universities and companies. Until now, the training center is still running and has conducted several training activities.	through joint control of the collaboration carried out Institutional proximity: there are common norms and values Social proximity: there are social relations among actors at the micro level
CS-7	Marketing innovation and organizational innovation because this KUI has succeeded in establishing a startup and incubation center: Jamoetik which functions to provide information on herbal products and traditional medicine and is able to organize herbal medicine stakeholders in Indonesia	Cognitive proximity: there are common knowledge base and expertise of collaborating actors Organizational proximity: interaction process through joint control of the collaboration carried out Institutional proximity: there are common norms and values. Social proximity: there are social relations among actors at the micro level and trust arises based on friendship
CS-8	Innovation of interactive tele-assessment products based on artificial intelligence psychology. The company has purchased a product license and is currently continuing to develop and market it	Cognitive proximity: there are common knowledge base and expertise of collaborating actors Organizational proximity: further interaction process after the spin-off process Institutional proximity: there are common norms and values. Social proximity: social relations among collaborating actors

Table 4.
Innovation Performance of Universities

Case Study	Universities' Innovation Performance					
	DIO	IIO				AI
		CP	OP	IP	SP	
CS-1	The number of joint publications with industry increases, the number of patents and IPRs increases, and can business opportunities can be created for research results	√		√	√	Exposing students and lecturers to practical problems and cutting-edge technologies, providing a positive effect on curriculum & learning innovation, providing a "testing ground" to get feedback on research ideas, results/interpretations for improving academic ideas/theories, stimulating technological progress and/or research activities in certain fields, can provide training and job opportunities for students, building credibility and trust for academic researchers among practitioners, stimulating the

						development of spin-offs and startup ideas and the creation of case studies in learning
CS-2	The number of publications increases, the number of patents and IPRs increases, and new roadster bicycle startup as a form of downstreaming research results	√		√	√	Exposing students and lecturers to practical problems, new ideas, and cutting-edge technologies, providing a positive effect on curriculum & learning innovation, lecturers and students have new experiences in activities outside the campus, can provide training and job opportunities for students, build credibility and trust for academic researchers among practitioners, stimulate the development of spin-offs and startup ideas and the creation of case studies in learning, and at the same time build collaborative relationships and entrepreneurial culture and climate among lecturers and students.
CS-3	The number of publications increases, the number of patents and IPRs increases			√	√	Exposing students and lecturers to practical problems, new experiences of lecturers and students in activities outside the campus and interacting with industry players, and the creation of case studies in learning
CS-4	The number of publications and the number of patents increases, and the commercialization of research results occurs	√		√	√	Exposing students and lecturers to practical problems, new ideas, and cutting-edge technology, has a positive effect on curriculum innovation & learning method innovation, provides a "testing ground" to get feedback on research ideas, can provide training and job opportunities for students, stimulate the development of spin-offs and startup ideas for students so as to stimulate the growth of the campus entrepreneurial climate.
CS-5	The number of publications and IPRs has increased.				√	Exposing students and lecturers to practical problems, new experiences of lecturers and students in activities outside campus and interacting with industry players.
CS-6	The number of joint publications and IPRs has increased, the establishment of a solarpreneur center as a business incubator.	√	√	√	√	Exposing students and lecturers to practical problems, new ideas and cutting-edge technologies, giving positive effects on curriculum innovation & learning method innovation, new experiences of lecturers and students doing activities outside campus and interacting with industry players, stimulating technological progress and research activities in certain fields, acquisition or access to the latest equipment in industry, providing internship and work opportunities for students, and stimulating the growth of an entrepreneurial climate among academics

CS-7	Number of joint publications, number of patents and IPRs increases, number of innovation ideas, new business startups	√	√	√	√	Exposing students and lecturers to practical problems, new ideas, and cutting-edge technologies, giving positive effects on curriculum innovation & learning method innovation, new experiences of lecturers and students doing activities outside campus and interacting with industry players, stimulating technological progress and research activities in certain fields, and stimulating the growth of an entrepreneurial climate among academics
CS-8	Number of publications and patents increases and patents have been licensed by industry	√	√	√	√	Exposing students and lecturers to practical problems and cutting-edge technologies, providing positive effects on curriculum innovation & learning method innovation, can provide training and internship and work opportunities for students, stimulate the development of spin-offs and startup ideas, and stimulate the growth of an entrepreneurial climate among the academic community.

The research results above show that university and industry collaborations in all the MF case studies obtained significant innovation performance results for partner companies. All case studies yielded DIO results in the form of product innovation and process innovation (CS1, CS2, CS3, CS4, CS5, and CS8), organizational innovation (CS6), and marketing and organizational innovation (CS4, CS7). The results of this study are in line with and support the findings of previous studies that showed that UIC with formal collaboration forms (formal target agreements, formal non-target agreements, and focused structures)—in developing countries involving the role of the government—tend to yield positive results in terms of improving the company's innovation performance (Song et al., 2022). In his study on manufacturing industry collaboration with the concept of public linkage (with universities and government), Lianto (2023) showed that this collaboration can significantly increase industrial innovation capabilities.

In addition, most of these UIC MF collaborations provide IIOs in the form of cognitive proximity, institutional proximity, and social proximity. Several case studies even have an impact on organizational proximity (CS6, CS7, and CS8). Cognitive proximity occurs largely because the collaborating actors there have a common knowledge base and expertise at the micro level meaning that future cooperation will be strengthened. Franco & Haase (2015) said that collaboration due to a common knowledge base and expertise and direct contact without bureaucracy will strongly support the success of the collaboration. This is the same as (Gilsing et al., 2016) who stated that cognitive proximity can also support the occurrence of social proximity meaning that trust arises based on friendship and the experience of the relationships that have been established so far.

Meanwhile, institutional proximity occurs because fellow collaborators see and feel that there are common norms and values between universities and companies meaning that the parties feel confident and optimistic that the collaboration can continue in the long term.

Several previous studies have stated that the dissimilarity of values and norms between universities and industry is often a significant obstacle to establishing long-term cooperation (Dubouloz et al., 2021). On the other hand, in CS6, CS7, and CS8, organizational proximity was established because collaboration caused both parties to agree to exercise joint control over the subsequent cooperation process. The interesting thing about the results of this study is that those for IIO between the industry and the university academics are the same. This situation shows that, what is felt by the collaborators from both parties, is more or less the same, meaning that in the long term, this collaboration will continue to develop and have a wider impact on both parties.

From the university's perspective, the UIC MF collaborations, in all case studies, showed positive DIO results. Academics in all case studies said that collaboration with industry facilitated by the government through the MF project yielded positive results in terms of increasing the number of publications and obtaining patents and IPRs, as well as new business opportunities. Some case studies even obtained results up to the establishment of business incubators and research downstreaming (CS1, CS2, CS4, CS6, CS8). Meanwhile, as for the aspect of academic innovation, it can be seen that the UIC between the University of Surabaya and several partner companies yielded quite positive results. All case studies showed that the minimum results of the UIC had an impact on opening up opportunities for students and lecturers to know and understand practical problems, giving lecturers and students new experiences in activities outside the campus, and interacting with industry players. Several case studies show maximum results because UIC is able to encourage curriculum innovation, learning about method innovation, and the growth of an entrepreneurial climate among academics (CS1, CS2, CS4, CS6, CS7, and CS8). The maximum impacts on academic innovation were seen in case studies that had a fairly long duration of cooperation (over five years) in CS1, CS2, and CS4, while in CS 6-8, although the duration of formal cooperation is less than five years, the relationship between company leaders and university leaders had been established for a long time. While the minimum results of academic innovation in CS3 and CS5—apart from being due to the relatively short duration of cooperation, and based on the results of further interviews—are also due to the absence of mutual trust and good coordination and communication between the PICs of the two parties. Sjöö & Hellström (2019) said that the results of previous research related to UIC showed that the duration of cooperation and prior experience were the strongest predictors. In addition, as seen from the data above, generally, case studies that have an impact on academic innovation are UICs that have all the proximities: cognitive proximity, organizational proximity, institutional proximity, and social proximity. This situation is in accordance with the reason stated by Alpaydın & Fitjar (2024) that proximity with its multiple dimensions is very important in producing the effectiveness of UIC.

5. Conclusion

The results of this study indicate that the forms of interaction that occur between individual academics and industry practitioners in the UIC Matching Fund (MF) are very diverse, ranging from informal to very formal interactions. The number and form of interactions that occur are not influenced by the duration of the collaboration but are more influenced by the quality of the leaders of the companies and universities, good relationships and mutual trust between the two parties, and good relationships and coordination and communication between the persons in charge (PICs) of the two parties. The results of this study indicate that UIC MF provides direct innovation outcomes (DIO), specifically product and process innovation, and indirect innovation outcomes (IIO) for the company. On the other hand, UIC MF also provides positive DIO results, from an

increase in the number of publications, the number of patents and IPRs, and innovation ideas, to the results of commercialization of research and university IIO; however, not all UIC projects provide maximum results for academic innovation (AI). Several case studies have yielded maximum AI results because UIC is able to encourage curriculum innovation, learning method innovation, and the growth of an entrepreneurial climate among academics. The maximum impact on AI came from case studies that had a fairly long duration of cooperation (over five years) and created mutual trust and good coordination and communication between the PICs of the two parties. Thus, it can be concluded that the duration of cooperation, mutual trust, and good coordination and communication all have a greater influence on AI.

The results of this study have practical implications and will provide comprehensive input for the government and the University of Surabaya (Ubaya) in improving various policies that encourage a more qualified and productive UIC process in the future. The results of this study (although only limited to one private university) show that the government's MF program has successfully facilitated UIC because it has had a positive impact on industry and universities. To provide a more optimal impact, especially on increasing academic innovation for universities, the conditions for providing funding should require the collaboration between universities and industry to have a long duration (for example, at least 5 years) and to have shown good initial results due to mutual trust and good coordination and communication. In addition, the results of this study will provide an overview for Ubaya about the various UIC outputs and outcomes related to innovation performance in all aspects of the implementation of the *tridharma* (traditional philosophy) of higher education, especially academic innovation performance dan bisa dijadikan dasar bagi pemilihan mitra kolaborasi di masa depan.

The limitation of this study is that it does not discuss the motivations and obstacles that occur in the UIC process which may have an influence on the innovation performance that is achieved. In addition, the conclusion of this study only applies to the case of UIC at Ubaya with several industries in the MF project. Therefore, it may not necessarily result in the same conclusion in different cases (different universities, industries, and projects). A suggestion for future research is a study on measuring innovation performance in UIC that also pays attention to other aspects such as motivation and various obstacles in the collaboration process. It would be interesting to study the impact of UICs on innovation performance by involving various universities, wider industries, and various project characteristics.

Declarations

Author contribution

All authors contributed equally as the main contributors of this paper. All authors read and approved the final paper.

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Competing interest

The authors declare that they have no conflicts of interest to report regarding the present study.

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