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The way of human resource development and resource/infrastructure management affect the agroindustrial innovation process in a merged public research institution

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Abstract

Purpose: This study aims to reveal how strong the influence of human resource development and resource/infrastructure management on innovation process during the merger of public research institutions by shaping researchers' skills. The proposed research model is intended to reveal how distinctive competency possessed by human resource and resource/infrastructure management encourages the innovation process during the merger.

Design/methodology/approach: Using partial least square structural equation modeling (PLS-SEM) and involving 204 respondents, it is revealed that human resource development influences researchers' adaptive and absorptive skills slightly stronger than resource/infrastructure management to encourage the innovation process during the merger of public research institutions.

Findings: It is revealed that knowledge vacuum, which was unintentionally generated through chaotic condition during the merger, brought a positively significant influence on innovators' distinctive competency through both adaptive and absorptive skills. This also implies that chaotic events within a dynamic research environment might stimulate open innovation process. In this regard, human resource management is expected to organize more training and coaching practices to minimize knowledge vacuum and enhance innovators' distinctive competency.

Research limitations/implications: This study was conducted by selecting a merged public research institution in Indonesia as the model case, meaning that the approach is probably not suitable to be applied to the condition in other countries due to different governmental rules and organizational process. Thus, cross-countries examination utilizing merged researches on organizational cases will be a suitable approach and valuable compass for future studies.

Practical implications: Firstly, from the insight of human resource development, it is important to give equal opportunity in terms of skill and knowledge development to each innovators. Moreover, giving proper incentives can boost innovation desire that eventually boost innovation process. Secondly, human resource development and resource/infrastructure managements have a balance effect to support adaptive and absorptive skills. Managers should pay attention to properly manage the innovation resources and infrastructures so that innovators can utilize them right away without having to wait in line for too long.

Originality/value: This study was conducted by selecting a merged public research institution as the model case and focused on researchers' innovation process. Merging public research institutions domestically was considered a first-time worldwide phenomenon. Previously, innovation process was only discussed in the context of commercial sectors and higher education institutions.

Keywords: Human resource development, Resource/infrastructure management, Knowledge vacuum, Merged public research institution, Structural equation modeling.

Jel Codes: L2, L3, O3

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1. Introduction

Indonesia has been known for decades as a large agro-maritime country (Kiloes, Sulistyaningrum, Khaririyatun, Mulyono, Prabawati, Anwarudin-Syah et al., 2024). This means its gross domestic product relies on agroindustrial comodities (Ginting, 2015) and its regional innovation system also focuses on the development of agroindustrial innovation (Ali, Machfud, Sukardi, Noor & Purnomo, 2023; Muchtar, Palar & Amirulloh, 2023; Kiloes et al., 2024). Recently, domestic research and development (R&D) institutions, such as BPPT, LAPAN, BATAN, LIPI, and research unit of particular ministries, had merged to form the National Research and Innovation Agency (BRIN) to enhance national innovation system. This merger has brought not only supporting situations for agroindustrial researches, but also several unfavorable situations, especially the ones that impact individual aspects, such as the loss of individual competency and the loss of knowledge flows. Meanwhile, during this change due to institutional merger, innovation process has to be carried out smoothly (Ginting, 2015).

In Indonesia, agroindustrial sectors had been contributed to 38% of gross domestic product (GDP) yearly and this number was higher than that of other sectors, such as fashion, pharmacy, and textiles (Muchtar et al., 2023). R&D activities play an important role in innovation performance, since they determine the success of the commercialization of applied knowledges (Valerio, Hilmiati, Prior & Dahlanuddin, 2022; van Lieshout, van der Velden, Blomme & Peters, 2021). According to Furr and Shipilov (2018), innovation process consists of four stages: search, select, implement, and launch. In agroindustrial innovation process, each stage combines technical improvements, scientific knowledge, and market demands to develop creative solutions for dealing with agricultural challenges (Valerio et al., 2022).

When organizational structure changes due to institutional merger, standard regulations of managing human resources and infrastructures also change (Calipha, Tarba & Brock, 2010; Peng, 2019). During this merger, people movements can affect information flows, which eventually cause knowledge loss or vacuum (Choi & Chandler, 2020). Due to these chaotic events, unprecedented knowledge vacuum can intervene the existing technological and social knowledge as the basis of agroindustrial innovation process. Moreover, agroindustrial innovation mostly requires more advanced technological involvements, such as prototype development, which necessitates detailed understanding of specific technological knowledge and innovation process. Without experts and proper knowledge flows, agroindustrial innovation process could not be carried out smoothly as planned (Wensley & Navarro, 2015). Moreover, during organizational change due to merger, establishment of standard operational procedures (SOP) is also crucial to settle a standardized day-to-day activities (Rossi, Tarba & Raviv, 2013). Provision of policy guideline has been a primary focus on managing innovation, but daily innovation process planning is the one that determines success rate. In this regard, managers who are able to accordingly executed SOP in daily activities are able to significantly improve target performance.

Previous studies had revealed that human resource development played important role in managing capabilities during the merger in several public sectors, such as banking, pharmacy, universities, and computing (Bennato, Davies, Mariuzzo & Ormosi, 2021; Heller-Schuh, Lepori & Neuländtner, 2020; Nyuur, Donbesuur, Owusu-Yirenkyi, Ampong & Tantawy, 2023; Anvari, Janjaria & Shirvani, 2024). In merger situation, human resource management team also ensured that the process complied with legal requirements to prevent potential legal matters. A merger case of state-owned company showed that over-ambitious policy designs that did not consider job designs and loads had been the main driver of innovation failure (Simamora, 2023). On the other hand, implementing new policies during the merger through trial and error approach was one of the reasonable way to evaluate their effectiveness (Aagaard, Hansen & Rasmussen, 2016). To date, the roles of human resource development during institutional merger are still being questioned. Garavan (2007) highlighted that managing human resource during the merger was needed to be carried out carefully to retain valuable employees for maintaining critical capabilities within the merged entity.

Apart from human resource management, allocating facilities and infrastructures were also essential means to support innovation process during organizational changes (Chen, Zhu & Wang, 2021; Engelsberger, Bartram, Cavanagh, Halvorsen & Bogers, 2023). During the merger, innovation process was fostered by efficient facility and infrastructure management. In addition, resources were used as efficiently as possible, technology was integrated, flexible work environments were supported, safety and compliance should be guaranteed, sustainability was encouraged, and change was tolerated. Collectively, these elements fostered an environment that shaped creativity within the merged entities (Lin, Patel & Oghazi, 2021). Based on the findings of several previous studies, facility and infrastructure management were identified as a single antecedent factor of innovation performance (Colombo & Rabbiosi, 2014; Xiong, Yang, Zhou & Wang, 2022), rather than being examined simultaneously with other factors. Recent studies showed that resource and infrastructure management was as important as other factors, such as managerial commitment and procurement management, to maintain innovation process during the merger in commercial industries (Nakagawa & Matsushima, 2023). A study by Bashir, Alfalih and Pradhan (2023) stated that uncompetitive manufacturers who were lacking of economies of scale and technological know-how were unable to process their resources effectively. In addition, previous studies also showed that precise decision making on market know-how was driven by adequate distinctive competency of innovators. Meanwhile, it was evident that adaptive and absorptive skills strongly influenced innovation performance through distinctive competency (Bolívar-Ramos, García-Morales & García-Sánchez, 2012; Bouguerra, Mellahi, Glaister, Sadeghi, Temouri & Tatoglu, 2022; Wang & He, 2021). In addition, previous studies also had separately examined the impact of managerial supports, human resource, infrastructure management, and distinctive competency on innovation process.

Through years, studies on the role of distinctive competency had been conducted solely from the perspective of individual characteristics (Fernandez, Lara, Ugalde & Sisodia, 2018; Hulke & Diez, 2020), rather than integrating it with the perspective of managerial performance. Innovation process and merger cases in commercial sectors also had been evaluated by previous studies (Bennato et al., 2021; Nakagawa & Matsushima, 2023). However, there does not seem to be any study that specifically examines the innovation process in the context of the merger of public research institutions. To date, innovation process had only been analyzed by examining various business operations (Bouguerra et al., 2022; Nakagawa & Matsushima, 2023) Therefore, examining the impact of human resource development and resource/infrastructure management on adaptive and absorptive skills is very important to navigate the agroindustrial innovation process during the merger of public research institutions. The proposed contribution and unique analysis of this study are characterized by the explanation of relationship between knowledge vacuum and distinctive competency in the agroindustrial innovation process. Furthermore, this study is expected to fill the theoretical gap in the theme of human resource development and infrastructure management that can maintain innovation process during an institutional merger. The findings of this study is aimed to be implemented by decision makers to obtain strategical steps for maintaining innovation process and enhancing innovators' distinctive competency.

2. Theoretical Background

2.1. Institutional Merger and its Impact on R&D Activities within Agroindustrial Innovation

One purpose for an institutional merger is to pool financial resources. A merger might lead to the needs of higher R&D budgets to realize the newer and bigger business, thus allowing for more substantial investments in agricultural and associated sectors through research, technology, and innovation. A merger would also result in expertise synergy, namely by bring together various experienced teams from various institutions. This pooling of knowledge and expertise has the potential to generate new ideas, cross-disciplinary partnerships, and novel approaches to deal with various difficulties concerning R&D activities. Furthermore, merger may force a rethinking of R&D objectives, besides also inducing operational improvements, such as by improving supply chains or enhancing manufacturing processes, all of which might free up resources that could have been allocated to R&D activities. By doing this, merged institution can engage more actively in R&D activities to sustain organizational performance, leading to breakthroughs in agroindustrial technology and expertise, such as by producing efficient feedback systems in the agroindustrial innovations (Anvari & Askari, 2024). Besides, partnerships between merged public research institution and private sectors and/or universities are also highly possible. By applying open innovation and utilizing external experience, resources, and cutting-edge technology, these collaborations may stimulate better R&D innovation. However, merging various public research institutions also can lead to inevitable challenges, such as integration concerns and regulatory obstacles. For example, a newly integrated laboratory can be hard to operate smoothly due to new bureaucracy and sectoral ego concerning resources ownership issue. Several authors found that the quality of managing human resource mobilization and infrastructure allocation can greatly affect innovation performance during organizational change (Aagaard et al., 2016; Bennato et al., 2021; Nakagawa & Matsushima, 2023; Wang & He, 2021). A study from Ali et al. (2023) examined how human resource development in agroindustry company could affect the adaptive skills of employees within a dynamic environment, and it was concluded that two-ways communication and proper opportunities of trainings might boost innovation process to fulfill innovation outputs. Somehow, difficulties that arise due to merger are caused by organizational inertia, such as distrust and knowledge loss, which might bring negative impact on innovation process. Nonetheless, knowledge emptiness also might encourage innovators to seek external collaborations (Ryu, Baek & Yoon, 2021).

2.2. The Role of Human Resource Development and Resource/Infrastructure Management

Both resource/infrastructure management (RIM) and human resource development (HRD) play critical roles in supporting the smooth integration of knowledge and operations during an institutional merger. When two institutions merge, their infrastructures might be incompatible at first. Various systems, databases, and softwares could obstruct the free flow of information. If the merged organizational systems are not linked efficiently or if there is a lack of interoperability, it could generate gaps where data and knowledge had become fragmented or inaccessible, and eventually cause a knowledge vacuum (KV) (Choi & Chandler, 2020; Khan, Tao & Li, 2022). Furthermore, merger brought together people from various institutions. As a consequence, silos—isolated group or department that function apart from others, especially in a way seen as hindering work operations—and communication barriers might occur if HR management does not actively try to bridge these cultural gaps or if appropriate communication strategies are not used. Because of uncertainty or disagreements in work processes during the merger, employees might withhold or struggle to share critical knowledge, thus deepening the knowledge vacuum. There may be even a loss of tacit knowledge —the valuable skills and insights maintained by employees— as a result of the merger. The failure of HR departments for capturing and transferring significant information throughout the transition could result in a loss of critical insights and experiences. Furthermore, during a merger, uncertainty regarding job security or duties might lead to decreased productivity (Azizi, Atlasi, Ziapour, Abbas, & Naemi, 2021; Berkhout, Hartmann, van der Duin & Ortt, 2006; Wang & He, 2021; Zhang, Zhang & Daim, 2023). For this reason, human resource management should resolve these issues as soon as possible or provide clear instructions so that employees can focus on performing in a conducive and supportive work environment rather than creating false information that cause a knowledge vacuum.

Post-merger infrastructural changes and new work processes often require training and support (Bouguerra et al., 2022; Cai, Lin & Zhang, 2023; Martínez-Sánchez, Vicente-Oliva & Pérez-Pérez, 2020; Rossi et al., 2013). Thus, it is important for HR department to provide employees with the necessary trainings and knowledges so that they can adapt themselves to new systems and work processes. Otherwise, this can lead to a lack of productivity and ineffective use of available resources. Moreover, infrastructure changes or new policies may face resistance within the integrated institution. To deal with this, for example, line managers can establish agile decision-making to minimize frictions within new teams or organizations (Anvari et al., 2024).

When resistances increase due to institutional merger, people become reluctant to adapt themselves to new practices or share valuable insights. For this reason, HR managers must appropriately address these issues through their strategies and decision-making capabilities. Therefore, based on these notions, the proposed hypotheses here are formulated as follows:

H1: RIM has a positively significant influence on KV

H2: HRD has a positively significant influence on KV

2.3. The Role of Knowledge Vacuum on Distinctive Competency

Absorptive skills referred to an organization's ability to recognize the values of new external information, assimilate these values, and apply these values to realize innovation ends. Meanwhile, adaptive skills comprise the capacity to adjust, change, or modify the behaviors, strategies, or processes based on new information or changing circumstances (Choi & Chandler, 2020). A knowledge vacuum (KV) is defined as a situation where there is a lack of information, learning resources, or expertise in a particular area. If KV happens, it significantly affects both absorptive and adaptive (AA) skills, ultimately affecting distinctive competency (DC). In a knowledge vacuum, with limited or outdated information available, an organization or an individual might struggle to absorb new knowledge effectively (Duan, Deng, Liu, Yang, Liu & Wang, 2022; Khan et al., 2022). This might hinder their ability to understand and utilize new information, thus reducing their absorptive skills. As a result, they might miss out on new innovations, trends, or advancements that are crucial and useful to improve their distinctive competency. Similarly, the lack of updated information or learning resources due to knowledge vacuum could impede individuals' ability to adapt themselves accordingly. Conversely, when a knowledgeable employee has been triggered by uncertain condition, this person would initiate to seek information from external environment to fulfill performance targets (Bashir et al., 2023). Therefore, a knowledge loss can sometimes turn on one's survival capability to seek what is necessary. Therefore, based on these notions, the proposed hypotheses here are formulated as follows:

H3: KV has a positively significant influence on AA

H4: KV has a positively significant influence on DC

2.4. The Role Of Adaptive And Absorptive Skill On Innovation Process

Distinctive competency refers to a unique strength or capability possessed by an organization that sets it apart from its competitors and enables it to achieve a competitive advantage. This competency is something that the organization does exceptionally well or possesses uniquely, making it difficult for competitors to replicate or imitate (Fu, Luan, Wu, Zhu & Pang, 2021; Khan et al., 2022). Organizations with highly adaptive capacity tend to exhibit better agility and flexibility in their approaches. This agility allows them to experiment with new ideas, technologies, or business models, which are crucial elements in fostering innovation process (IPROS) (Bashir et al., 2023; Bouguerra et al., 2022; Fouad, Tourabi & Lakhnati, 2018). In this regard, when knowledge vacuum appeared among innovative and knowledgeable workers, it does not significantly affect their performance since they had the agility to seek new resources and information (Dandira, 2012). The synergy between adaptive and absorptive skills drives an organization's ability to evolve, innovate, and develop distinctive competencies, positioning them favorably in dynamic and competitive environments. Adaptive and absorptive skills are considered more significant as the intervening variable rather than as the moderating variable when it comes to the necessity for performance enhancement (Symeonidou, Leiponen, Autio & Bruneel, 2022). Thus, based on these notions, the proposed hypotheses here are formulated as follows:

H5: AA has a positively significant influence on DC

H6: AA has a positively significant influence on IPROS

H7: DC has a positively significant influence on IPROS

Therefore, based on the above theoretical discussion, the proposed research model in this study are constructed as follows:

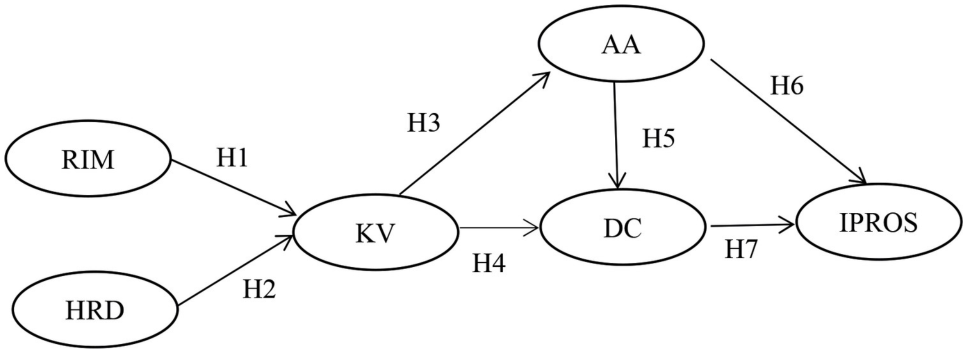

Figure 1. Proposed research model in this study

3. Method

3.1. Sample and Data Collection

This study employed purposive sampling technique. Empirical data were collected through a self-administered survey. Targeted respondents were innovation actors, namely researchers and engineers, who are involved in the scope of agroindustrial R&D projects in BRIN. The position levels of the respondents were varied, namely assistant, junior, senior, and principal innovators (researchers and engineers). The respondents' subject of expertise comprised two main areas: science and technology and human resources. The survey was conducted from September 2022 to June 2023. A total of 204 valid responses were obtained, and this number were considered sufficient, as the minimum number of respondents that are considered valid to be processed is five times the number of questions (Hair, Ringle & Sarstedt, 2011). As many as three researchers from the 204 selected respondents were also selected to be interviewed This study also identified the type of research, namely by dividing it into basic and applied R&D. Basic R&D is mainly intended to fill theoretical gaps, meanwhile applied R&D focuses on practical outputs to be implemented in real-life conditions (Heller-Schuh et al., 2020). Then, since the merger has brought organizational change that has impacted the project continuance, it is also necessary to include the status of project continuance, as it would affect the individual preferences about innovation process and stability during the merger (Sułkowski, Fijałkowska & Dzimińska, 2019). Table 1 depicts the respondents' profile.

Characteristic	Classification	Number	Percentage (%)
Gender	Female	145	71.08
	Male	59	28.92
Position	Assistant	45	22.06
	Junior	31	15.20
	Senior	98	48.04
	Principal	30	14.71
Type of R&D	Basic R&D	87	42.65
	Applied R&D	117	57.35
Project Continuance	Continue	100	49.02
	Discontinue	104	50.98

Table 1. Respondents' profile

3.2. Common Method Bias (CMB) Assessment

This study used variance inflation factor (VIF) value to evaluate CMB by examining its full collinearity testing. If all VIF values are equal to or less than 3.3, it means the propose research model is out of CMB. The CMB assessment results are shown in Table 2.

Construct	Code	Loading	T-Value	VIF	α	CR	AVE
Adaptive and Absorptive Skills (AA)					0.87	0.87	0.65
	AA1	0.85	29.30	2.29			
	AA2	0.78	14.10	1.95			
	AA3	0.80	10.65	1.96			
	AA4	0.82	20.21	2.11			
	AA5	0.75	11.59	1.71			
Distinctive Competency (DC)					0.77	0.80	0.54
	DC1	0.75	13.66	1.58			
	DC2	0.47	3.92	1.34			
	DC3	0.79	17.88	2.16			
	DC4	0.84	22.59	2.91			
	DC5	0.73	10.68	1.96			
Human Resource Development (HRD)					0.79	0.81	0.62
	HRD1	0.76	12.80	1.66			
	HRD2	0.83	23.18	1.79			
	HRD3	0.81	19.78	1.72			
	HRD4	0.74	10.79	1.56			
Knowledge Vacuum (KV)					0.81	0.83	0.64
	KV1	0.66	7.15	1.35			
	KV2	0.82	16.88	1.95			
	KV3	0.89	43.59	2.38			
	KV4	0.83	17.93	1.93			
Innovation Process (IPROS)					0.80	0.83	0.51
	PI1	0.84	10.78	2.19			
	PI2	0.83	10.44	2.37			
	PI3	0.68	5.19	1.73			
	PI4	0.55	4.31	1.71			
	PI5	0.67	5.11	1.81			
	PI6	0.67	5.93	1.35			
Resource and Infrastructure Management (RIM)					0.90	0.95	0.83
	RIM1	0.87	21.75	2.49			
	RIM2	0.92	45.62	3.14			
	RIM3	0.94	92.28	3.01			

Table 2. CMB assessment results

3.3. Measures and Scales

The scales used in this study were adopted from previous relevant and valid studies. All items were scored using a 4-point Likert scale, which ranges from 1 (strongly disagree) to 4 (strongly agree). This type of Likert scale does not provide neutral option, thus it would minimize bias caused by neutral answer from respondents (Hair et al., 2011). Beforehand, a pretest was carried out by two principal innovators and four senior innovators to enhance the readability and language structures of the constructs and items. Each latent construct was adjusted based on previous respective studies, as shown in Table 3. The descriptions and detailed items also explained in Table 3.

3.4. Data Analysis

For data analysis, this study utilized partial least square (PLS) path modeling, also well-known as PLS-SEM (partial least square structural equation modeling). PLS-SEM is considered suitable to measure a causal predictive model, such as the proposed research model in this study. Furthermore, there are also several factors to justify the suitability of PLS-SEM in this study as the means for data analysis (Hair Jr., Hult, Ringle & Sarstedt, 2016): 1) the testing complexity of the proposed model in relation to the relative impact of exogenous latent constructs on endogenous latent constructs; 2) this study aims to predict and explain the variance of the proposed model; 3) exploration and early development of theoretical model that are expressed in the proposed model. Furthermore, model goodness of fit was also identified using standardized root mean square residual (SRMR).

Description	Code	Item
Adaptive and Absorptive Skills (Isip, 2022)		
Adaptive and absorptive skills are critical, both in navigating organizational changes and learning in various contexts, especially in the workplace.	AA1	I routinely upgrade my knowledge and information so as to stay relevant in my R&D activities
	AA2	I utilize facilities and infrastructures properly to carry out innovation activities
	AA3	I usually define my strategic plan before and after conducting my R&D activities so as to enhance the possibility to reap the maximum benefits
	AA4	I easily adapt myself to new work environment to keep on with the smoothness of the innovation process
	AA5	I always learn new technologies and theories to support my R&D activities
Distinctive Competency (Fernandez et al., 2018)		
Unique competencies that are possessed by innovators, which support the maximum innovation performances, such as producing several numbers of intellectual properties and using critical thinking to conduct innovation process.	DC1	I have strong capability of producing scientific papers, both within national and international scope
	DC2	I am capable to make prototype or policy briefs based on my R&D activities
	DC3	I am competent to conduct R&D collaboration, both with national and international partners
	DC4	I think I use my logic and critical thinking in conducting my R&D activities
	DC5	I actively update my technology and social knowledge
Human Resource Development (Garavan, 2007; Fu et al., 2021)		
Managing human resource according to their competencies, compensating their performance, and giving fair opportunities to develop their skills. These activities also include performance assessment, either periodically or transparently.	HRD1	The recruitment standard by HR department has met the competencies of post graduate candidates
	HRD2	HR management has given equal opportunity to all innovators
	HRD3	HR management has given the exact compensations to all innovators who perform well in their R&D activities
	HRD4	HR management has measured innovation performance of all innovators transparently and periodically
Knowledge Vacuum (Choi & Chandler, 2020)		
A situation where there is a lack of information or understanding about a particular subject or topic. It can occur when there is no available or accessible source of information, or when the existing information is incomplete, outdated, or unreliable. A knowledge vacuum can pose significant challenges for individuals and organizations, as it can prevent them from making informed decisions or taking appropriate measures.	KV1	I feel that there is a loss (person or business process) during the organizational change due to the merger
	KV2	This organizational change due to the merger has made me less motivated to work
	KV3	In my opinion, there is a knowledge loss due to the merger
	KV4	Learning environment is less conducive due to the merger

Description	Code	Item
Innovation Process (Berkhout et al., 2006; Mukherjee, 2022)		
A sequence from defining problems, conducting innovation stages, to implementing innovation outputs in innovation activities	PI1	I can identify problems and define the concepts of the exact innovation process
	PI2	I can breakdown each phase of innovation process that I conduct and develop it into the new findings
	PI3	I can convert an innovation model into innovation output, such as prototype and policy brief
	PI4	I am open mind to all critics and supports for my innovation
	PI5	I correct my prototype and/or policy brief based on corrections
	PI6	I publish and commercialize my innovation outputs
Resource and Infrastructure Management (Symeonidou et al., 2022; Xiong et al., 2022)		
Commitments from management to engage a fair distribution and development of facilities and infrastructures	RIM1	In my opinion, resource and infrastructure management has allocated innovation resources and facilities fairly and consistently based on mutual agreements
	RIM2	In my opinion, resource and infrastructure management has fulfilled every commitments of well-managed innovation resources and infrastructures
	RIM3	In my opinion, resource and infrastructure management has allocated all resources and infrastructures for innovation activities smoothly and fairly

Table 3. Latent constructs and items descriptions

4. Result

4.1. Measurement Model Assessment

Reliability test was carried out by measuring standardized factor loadings and t-value. Suggested factor loading is equal or higher than 0.5, while suggested t-value is higher than 1.96 (two-tailed p = 0.05) (Hair Jr. et al., 2016). Based on the results in Table 2, it can be seen that the individual item reliability for all six constructs is declared acceptable. The reliability for each latent construct was determined using composite reliability (CR), while convergent validity was determined using average variance extracted (AVE). In order to be declared reliable, the CR value should be equal or higher than 0.70, and the AVE value should be equal to or higher than 0.50. As shown in Table 2, the proposed research model exhibits adequate construct reliability and convergent validity.

Next, Heterotrait-monotrait (HTMT) ratio and Fornell-Larcker criterion were used to measure the discriminant validity of each construct. According to HTMT, the acceptable value of a construct is suggested to be lower than 0.85 or 0.90 (Heidari, Kolahi, Behravesh, Ghorbanyon, Ehsanmansh, Hashemolhosini et al., 2018). Meanwhile, according to the Fornell Larcker criterion, the acceptable value of a construct is suggested to be higher than the correlation between the construct and any other construct. As seen in Table 4 and 5, the proposed research model exhibits prominent discriminant validity.

	AA	DC	HRD	IPROS	KV	RIM
AA						
DC	0.72					
HRD	0.66	0.61				
IPROS	0.18	0.42	0.25			
KV	0.55	0.48	0.65	0.12		
RIM	0.59	0.41	0.70	0.21	0.60	

Table 4. Model measurement results using Heterotrait-Monotrait (HTMT) ratio

	AA	DC	HRD	IPROS	KV	RIM
AA	0.80					
DC	0.60	0.73				
HRD	0.55	0.47	0.78			
IPROS	0.12	0.33	0.18	0.71		
KV	0.47	0.39	0.53	-0.05	0.80	
RIM	0,485	0,326	0,657	0,062	0,487	0,907

Table 5. Model measurement results using Fornell-Larcker criterion

4.2. Structural Model Assessment

First, multicollinearity of the proposed research model was calculated by checking the VIF values. The results show that the model has minimum multicollinearity in each set of predictor associations because all VIF values are lower than 5, as seen in Table 2. The goodness of fit was measured by calculating standardized root mean square residual (SRMR). SRMR with value of equal to or lower than 0.08 is declared a good model fit (Hair Jr. et al., 2016; Heidari et al., 2018). SRMR value of this model is 0.08, thus it can be concluded that the proposed model exhibits a significant goodness of fit. Next, the variance value (R^2) of the endogenous constructs of the proposed model were calculated to evaluate the explanatory power of the model. There are several classifications of R^2 values: 0.02 is considered a small/weak effect size, 0.13 is considered a medium/moderate effect size, and > 0.26 is considered a strong effect size. As seen in Table 6, the endogenous constructs of the proposed research model exhibit moderate to strong explanatory power.

Endogenous Construct	R2
AA	0.22
DC	0.38
IPROS	0.12
KV	0.35

Table 6. R^2 value of each endogenous construct

As seen in Table 7, there are five accepted hypotheses in this study: H1, H2, H3, H5, and H7, all of which have generated t-values more than 1.98. Meanwhile, H4 and H6 are rejected, because their t-values are less than 1.98. The results of H1, H2, and H3 reveal that resource/infrastructure management (RIM) and human resource development (HRD) affect knowledge vacuum (KV), and KV affects the adaptive and absorptive skills (AA) of innovators. Meanwhile, the results of H5, H6, and H7 reveal that adaptive and absorptive skills (AA) can only affect innovation process (IPROS) through distinctive competencies (DC). Based on the path coefficient value of each hypothesis, it can be seen that RIM and HRD have equal path coefficient values (both are 0.33). This means both RIM and HRD have equal influences on KV. Table 7 displays the direct path coefficient and t-value of each hypothesis.

Examining total indirect effects is also important to define which factors indirectly affect innovation process, especially in agroindustrial clusters during organizational change. As seen in Table 8, only AA—rather than RIM and HRD—that is able to indirectly and moderately affect IPROS. Additionally, KV is also not able to indirectly influence IPROS.

Hypothesis	Path Coefficient	T-Value	Conclusion
H1= RIM → KV	0.33	3.37	Accepted
H2 = HRD → KV	0.33	3.52	Accepted
H3 = KV → AA	0.47	5.94	Accepted
H4 = KV → DC	0.14	1.53	Rejected
H5 = AA → DC	0.54	6.83	Accepted
H6 = AA → IPROS	-0.12	0.80	Rejected
H7 = DC → IPROS	0.40	3.10	Accepted

(*) $p < 0.05$

Table 7. Hypothesis testing results (*)

	Loading	T-Value	Conclusion
AA → IPROS	0.22	2.68	Accepted
HRD → AA	0.15	2.66	Accepted
HRD → DC	0.12	2.52	Accepted
HRD → IPROS	0.03	1.41	Rejected
KV → DC	0.25	4.81	Rejected
KV → IPROS	0.10	1.64	Rejected
RIM → AA	0.15	3.00	Accepted
RIM → DC	0.12	2.65	Accepted
RIM → IPROS	0.03	1.38	Rejected

(*) $p < 0.05$

Table 8. Total indirect effects (*)

5. Discussion and Conclusion

5.1. Discussion of Results

As seen in Table 8, RIM and HRD have equal contributions to influence AA. This finding is supported by previous studies, namely that managing innovation infrastructures can properly facilitates employees so that they can adapt themselves to new skills and innovative thinking (Arias-Pérez, Velez-Ocampo & Cepeda-Cardona, 2020; Chen et al., 2021; Scaliza, Jugend, Jabbour, Latan, Armellini, Twigg & Andrade, 2021; Anvari, Kumpikaitė-Valiūnienė, Mobarhan, Janjaria & Hosseinpour-Chermahini, 2023). Moreover, developing human resource competencies through open-access training and coaching will shape employees' proactiveness and agility so that they can adapt themselves to dynamic work environment (Khan et al., 2022). Meanwhile, H3 states that KV has a significant influence on AA, meaning that chaotic events, which causing knowledge loss, will not degrade the adaptive and absorptive skills among innovative employees. Moreover, it was found that knowledge loss did not have the moderating effect on distinctive competency and innovation process (Ririh, Anggraeni, Machfud & Rochman, 2023). Since researchers in BRIN are high-achiever employees, they will utilize their networks and internal/external resources to fulfill innovation targets. However, this notion is not supported by previous findings, which stated that knowledge vacuum created a negative sphere and hindered innovation growth in commercial sectors. Workers with higher knowledge background will seek sources from external environment to fulfill their work performance. Moreover, knowledge vacuum may come together with team diversity during the merger, resulting in more creative work environment, but also with the potential of work frictions (Dandira, 2012; Anvari et al., 2024).

Infrastructure management and human resource development also play role to convert tacit knowledge —which is vulnerable to be loss due to knowledge vacuum— into elicit knowledge, as suggested by H1 and H2. A study by Choi and Chandler (2020) examined knowledge vacuum as moderating variable between management support and explorative and exploitative skills, but the resulting relationship was declared insignificant. New management that influence infrastructure and human resource arrangement in a newly merged institution tends to have unstandardized operation procedures, which leads to inadequate system supports to provide a thorough knowledge and information flows to employees (Arias-Pérez et al., 2020).

The proposed model in this study implies that strong adaptive and absorptive skill will boost distinctive competency in agroindustrial innovation during an institutional merger. Adaptive and absorptive skills enable researchers to seek external opportunity and utilize available resources, thus leading to the implementation of open innovation. This statement is supported by Respondent #3 (senior researcher) as follows:

…during this change, me and my team were helped by our colleagues in universities, but previously, we routinely worked together with them. We glad that we still have a joint project during this difficult time since the management often change the policy to conduct research…

Furthermore, knowledge vacuum in this model shows a positive significancy on adaptive and absorptive skills. However, this finding does not necessarily mean knowledge vacuum has a positive long-term impact, especially on agroindustrial innovation process, unless the employees are equipped with the proper incentives, benefit, and acknowledgement. In fact, the majority of researchers during the merger decide to work with the average performance. Chaotic events due to merger create rapid change policy related to research facilities and training opportunities. This statement is supported by Respondent #1 (junior researcher) as follows:

…since the bureaucracy and administrative sheets are more complicated nowadays, we just go with the flows. When I try to conduct partnership, dealing with joint contract draft will take too long. They—our partner—cannot wait that long. Not just that, right now, I convince that this institution has a huge number of hi-tech agroindustry laboratories, but when they experience breakdown, our work are also halted, whereas we are not able to work in other laboratories outside this institution.

Two-way communication that facilitated by management teams is important during the merger to unify understanding from various cultures. Without proper information and feedback, the innovators cannot enhance the innovation process accordingly, especially when the innovation involves advanced technology, such as in the agroindustrial research (Chen, Wang & Zhu, 2022). However, due to current merger, the day-to-day work operations have been performed mostly through one-way communication.

5.2. Conclusion

Based on the above discussion, it can be concluded that the way of resource/infrastructures management and human resource development treat individual skills and competencies will generate specific challenges during the merger of public research institutions. In this regard, there are three types of challenge: modified systems of innovation, research infrastructures movements, and communication burden, as shown in Table 9.

Variety of Challenges	Detailed Challenges
Modified systems of innovation	• More rigid systems, less agile • Complicated administrative requirements • Multiple reimbursement structures • Different standards for each units • Rapid change in rules without notification and socialization
Research infrastructures movements	• Long queue due to greater number of researchers who want to use the facilities • Mitigation system when the facilities are in maintenance or breakdown
Communication burdens	• Only one-way communication • Speech in virtual ceremony has suddenly become unwritten formal rules

Table 9. Specific challenges of a merged public research institution in Indonesia

This study has produced several theoretical contributions. First, this study uses broad measures to examine how human resource development and resource/infrastructure management can influence innovation process through the creation of unintended knowledge vacuum. This shows that knowledge vacuum does not always bring negative impact on individuals, but inversely has a positive impact on them, especially in the context of high achiever individuals. Second, the constructs of human resource development and resource/infrastructure management have the same portion to strengthen both adaptive and absorptive skills of innovators. In the previous studies, these constructs were measured separately and were only examined in the context of commercial sectors. Third, this study examines a novelty in public research sphere: the merger of public research institutions had just happened in Indonesia and this was considered a first-time worldwide phenomenon. Previous studies used merged universities or commercial industries as their model case, thus the findings of this study has generated new insight as the valuable guide to similar phenomena in the future.

Although the findings of this study contributes primarily to theoretical development, they also give several insights to managerial practices in order to resolve several issues. First, from the insight of human resource development, it is important to give equal opportunity in terms of skill and knowledge development to each innovator. Moreover, giving proper incentives can boost innovation desire that eventually boost innovation process. Second, human resource development and resource/infrastructure managements have a balance effect to support both adaptive and absorptive skills. Managers should pay attention to properly manage the innovation resources and infrastructures so that innovators can utilize them right away without having to wait in line for too long. During the merger of public research institutions, the most unfavorable factor that increase the perception of knowledge vacuum among innovators is the environment that discourages their motivation to learn. For this reason, managers should be capable to create supportive circumstances to motivate the innovators in learning new knowledge. Innovators, as high achievers, do not bothered by the loss of person or business process during the merger. They tend to find alternatives on how to achieve innovation outputs by utilizing the existing resources and skills. However, without managerial support to take care of innovators' work satisfaction and motivation, it will harm organizational innovativeness and competitiveness in achieving long-term targets. At last, it is important to enhance adaptive and absorptive skills before shaping distinctive competency. Innovators should be able to update their knowledge and information so as to stay relevant in their R&D activities, and they also should be willing to adapt themselves to dynamic innovation environments. Therefore, relevant programs, such as open discussions about innovation and open innovation fairs, should be conducted periodically to foster better knowledge and information exchanges. In addition, since the cores of conducting innovation process are identifying problems and defining innovation steps using logics, it is an urge to enrich innovators' ways of thinking with a specially-designed thinking framework through training and mentoring. Moreover, since the merger of public research institutions may reinforce open innovation, managers should carefully maintain the sustainability of work environment to encourage the proper open innovation performances of innovators.

This study encountered several limitations, which also can be seen as opportunities for future studies in this theme. First, this study only examined two factors that influence the innovation process, namely human resource development and resource/infrastructure managements, while the other possible factors, such as leadership styles, were not investigated. This may potentially affect our understanding about innovation process during institutional merger as a whole. Second, this study was conducted by selecting a merged public research institution in Indonesia as the model case. This means the approach is probably not suitable to be applied to the situation in other countries due to different governmental rules and organizational process. Thus, cross-countries examination using merged researches on organizational cases will be a more suitable approach and valuable compass for future studies. Third, even though this study applied a well-validated scale for measuring innovation process, this measure was subjective. Due to databases loss, this study could not use historical basis data to provide more dynamic models related to innovation process. Therefore, application of innovation basis data will be a prominent tool in future studies to predict the exact innovation process. Finally, this study gathered survey data with individual perspectives, which may suffer from bias. As an alternative solution, the use of databases encompassing longitudinal time-span is a possible method to be conducted in future studies.

Declaration of Conflicting Interests

The authors declare no potential conflicts of interest regarding the research, authorship, and/or publication of this article. Data will be available upon request.

The authors are responsible for the results, findings, and content of this article. In this study, Kirana carried out the experiment and wrote the manuscript with support and guidance from Prof. Machfud, Dr. Elisa, and Prof.

Nurul. Written or verbal consent had been made by each respondent before surveys and interviews were conducted.

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