“The effect of explorative and exploitative skills on innovation process during the merger of public research organizations”

AUTHORS	Kirana Rukmayuninda Ririh Machfud Elisa Anggraeni Nurul Rochman Nosica Rizkalla
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Kirana Rukmayuninda Ririh (Indonesia), **Machfud** (Indonesia), **Elisa Anggraeni** (Indonesia), **Nurul Rochman** (Indonesia), **Nosica Rizkalla** (Indonesia)

THE EFFECT OF EXPLORATIVE AND EXPLOITATIVE SKILLS ON INNOVATION PROCESS DURING THE MERGER OF PUBLIC RESEARCH ORGANIZATIONS

Abstract

This study aims to analyze the effects of explorative and exploitative skills, along with the moderating role of knowledge vacuum, on innovation process and performance during the merger of public research organizations (PROs) to better comprehend these organizational factors. During the merger of PROs, explorative and exploitative skills can prevent a slow innovation process and knowledge loss. Meanwhile, innovation also serves as PRO's core activity. However, the effect of explorative and exploitative skills (and also the knowledge vacuum) on the innovation process in PROs is still debatable, as they often disregard the knowledge loss effect. This study used 314 questionnaires, which were responded to by scientists of basic and technological research in Indonesia's merged PRO, namely the National Research and Innovation Agency (BRIN). Data were collected from 2023 to 2024 and analyzed using structural equation modeling (SEM) with Smart-PLS 4.0. The results reveal that the knowledge vacuum has a positive and significant influence on both exploratory-exploitative skills and absorptive-adaptive capabilities of scientists, which will eventually shape their distinctive competencies differently. However, despite the positive influence of the knowledge vacuum, the organization needs to strengthen scientists' explorative and exploitative skills by reinforcing strategic human resource management through periodic training, performing joint activities or active innovation hubs, and guiding scientists to cope with the dynamic transition periods due to mergers. All of them aim to reinforce knowledge exchange and research networks.

Keywords innovation process, explorative-exploitative skills, knowledge vacuum, organizational behavior, merger, public research organization

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Kirana Rukmayuninda Ririh, M.Sc., Ph.D. Student, Department of Agroindustrial Engineering, Faculty of Agroindustrial Technology, IPB University, Indonesia; National Research and Innovation Agency, Indonesia.

Machfud, Professor, Department of Agroindustrial Engineering, Faculty of Agroindustrial Technology, IPB University, Indonesia. (Corresponding author)

Elisa Anggraeni, Dr., Department of Agroindustrial Engineering, Faculty of Agroindustrial Technology, IPB University, Indonesia.

Nurul Rochman, Professor, Research Center for Advanced Material, Research Organization for Nanotechnology and Materials, National Research and Innovation Agency, Indonesia.

Nosica Rizkalla, Lecturer, Faculty of Business, Universitas Multimedia Nusantara [Multimedia Nusantara University], Indonesia.

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INTRODUCTION

Organizational merger is one type of strategic management that aims to achieve the most favorable business performance and organizational image. Nonetheless, innovations within newly formed work environments are often hampered due to performance stagnancy or even setbacks. A merger also brings dynamic and chaotic conditions into the newly formed organization. Since the output target of a research organization is innovation (Mukherjee, 2022), which often experiences a slowdown during a merger (Aagaard et al., 2016), it is important to conduct strategic measures on how to maintain and upgrade the innovation process and output during the merger.

Several factors influence the innovation process within a merged organization. Previous studies showed that explorative-exploitative skills and staffing systems shaped distinctive competency, and they had a

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positive influence (83%) on the success rate of innovation performance in a merged commercial hi-tech company (Calipha et al., 2010; Colombo & Rabbiosi, 2014). Infrastructure management plays a crucial role in facilitating a smooth transition during a merger, affecting workers' adaptation to the new work environment at approximately 63% (Rossi et al., 2013). Nonetheless, despite the significance of mergers for organizational performance, there are still few studies on how the innovation process needs to be maintained during organizational mergers.

Within the current condition of the newly merged organization, the chaotic event has already caused knowledge and process loss. However, Belte et al. (2023) stated that within a dynamic environment, scientists' networking skills can enhance knowledge span, which eventually leads to better work performance. Therefore, it is necessary to examine the significance of distinctive competency, which is shaped by explorative-exploitative skills, along with the moderating role of knowledge vacuum on the innovation process. Moreover, there are still limited studies that pay attention to merger cases of public organizations, especially public research organizations (PROs).

1. LITERATURE REVIEW AND HYPOTHESES

This study focuses on how to maintain the innovation process during the merger of public research organization (PRO). The innovation process is the organizational core activity of public research. The process refers to a sequence of activities that start from generating ideas to solving problems until creating innovative outputs that can be implemented (Ocampo et al., 2022; Valerio et al., 2022). This process can be affected by management decisions regarding facility allocation and scientist assignments, as well as by scientists' skills to adapt themselves and explore new knowledge (Duan et al., 2022). The input phase during innovation refers to the generation of innovative ideas based on actual problems. The process phase is defined as the implementation and correction measures within the innovation process to create an innovation prototype. The output phase is defined as the dissemination and/or commercialization of innovation outputs, such as policy briefs, prototypes, or products (Berkhout et al., 2006; Fouad et al., 2019; Selviaridis, 2021). In this study, the innovation process adopted the three phases above: input, process, and output.

Moreover, decisions made by the management board may impact the way they manage facilities and fulfill the need for skilled workers, such as scientists. Thus, managerial support in an organizational transformation should encourage more innovative and explorative work. Managerial support is a form of effective communication between managers and their subordinates, including providing clear feedback, assisting workers with challenging tasks, and involving them in important decisions (Tseole & Marutha, 2024). In addition, commitment to innovation planning for the short and long term is also a crucial part of managerial support. Organizations with strong managerial support will experience a positive impact on human resource management (for example, increased levels of productivity and profitability by 21%), especially on talent development. Human resource management refers to the practice of hiring, deploying, and managing employees. Previous studies showed that support from human resource management fostered positive employee relations in modern organizations, which also impacted the networking skills of each employee (Azizi et al., 2021; Banmairuroy et al., 2022; Cooke et al., 2021). In a research center or institution, scientists often need to disseminate their research output to share perspectives on current research and provide direction for future research. Scientists' networking skills are not just about selling but are also useful to sharpen their knowledge since they can enhance the quality of their future research (García-Cruz et al., 2024). However, human resource management during an organizational merger also faces several issues, such as communication gaps, uncertainty regarding employees' situations, and the loss of key talent. Failure in human resource management can lead to a flawed change management process, which can result in a loss of knowledge flow and innovation.

Knowledge loss, also known as a knowledge vacuum, is a type of organizational condition. It serves either as a pushing force to trigger innovation or as a pulling force to cause organizational inertia at both behavioral and structural levels (Choi & Chandler, 2020). During chaotic events due to mergers, structural change demands learning opportunity that exceeds the capacity and motivation of employees. In return, the knowledge vacuum can affect distinctive competency, which is shaped by absorptive-adaptive capability and explorative-exploitative skills (Situmorang & Japutra, 2024). Absorptive-adaptive capability is defined as an individual's ability to absorb new information, implement strategic measures, and adapt to a new work environment (Robertson et al., 2023; Yu et al., 2020). According to Gilsing and Nooteboom (2006), explorative skill is related to risk-taking, experimentation, and innovative findings. Therefore, it is believed that exploitative skill refers more to the effective and efficient utilization of knowledge and resources.

Organizational change increases uncertainty conditions and can decrease performance levels when the organization does not have standardized and informed operational procedures. As a consequence, this uncertainty can discourage employees from learning and adapting themselves to new knowledge and technology (Gilsing & Nooteboom, 2006; Iddris, 2016). In a newly merged research center, commitment from management also shapes scientists' trust to seek more funding and joint research. Thus, it is essential to examine the impact of explorative-exploitative skills and absorptive-adaptive capabilities on the innovation process and performance.

In a profit-oriented organization, a merger can strengthen the business by creating more value and reducing marketplace competition. Meanwhile, for a non-profit-oriented organization, a merger can lead to the aggregation of advanced technologies to smoothen daily operational activities (Thelisson, 2023). Moreover, combined knowledge and skills after a merger are expected to enhance learning and development opportunities, which eventually will strengthen the innovation process and performance (Chi et al., 2021; Fouad et al., 2019). Consequently, the more diverse facilities gathered after the merger, the more innovative outputs that are possible to produce. In addition, new facilities can also foster new knowledge.

Several previous studies examined the innovation process during mergers, mostly through the lenses of private companies and higher education institutions (G. Harman & K. Harman, 2008; Papa et al., 2020; Selviaridis, 2021). To date, the innovation process has only been explored separately, either by looking at organizational or individual factors. Moreover, the knowledge vacuum had been examined only in the context of e-government implementation (Choi & Chandler, 2020) and rarely analyzed in the context of public research organizational mergers.

This study aims to examine the effect of explorative-exploitative skills on the innovation process and performance during the merger of PRO. Besides, this study proposes that the knowledge vacuum affects explorative-exploitative skills and moderates the relationship between distinctive competency and innovation process. The following hypotheses are proposed in this study:

H1: Managerial support significantly influences resource and infrastructure management.

H2: Resource and infrastructure management significantly influences human resource management.

H3: Human resource management significantly influences knowledge vacuum.

H4: Knowledge vacuum significantly influences explorative-exploitative skills.

H5: Knowledge vacuum significantly influences absorptive-adaptive capability.

H6: Knowledge vacuum significantly influences distinctive competency.

H7: Absorptive-adaptive capability significantly influences distinctive competency.

H8: Explorative-exploitative skills significantly influence distinctive competency.

H9: Distinctive competency significantly influences innovation process.

H10: Innovation process significantly influences innovation performance.

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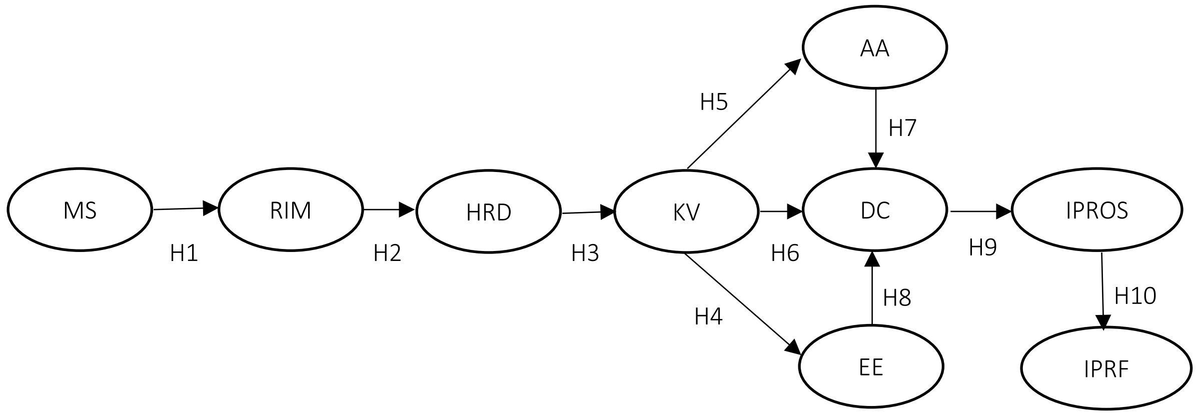

Note: IPROS = Innovation Process; IPRF = Innovation Performance; MS = Managerial Supports; RIM = Resource and Infrastructure Management; HRD = Human Resource Management; DC = Distinctive Competency; EE = Explorative-Exploitative Skills; AA = Absorptive-Adaptive Capability; KV = Knowledge Vacuum.

Figure 1. Conceptual framework

The conceptual framework in Figure 1 depicts the relatively complex relationships among several essential factors affecting the innovation process during organizational mergers. Consecutively, the framework starts from managerial support to knowledge vacuum, explorative-exploitative skills, and distinctive competency and ends with the innovation process and performance. This flow suggests that during dynamic conditions due to organizational mergers, the innovation process can be maintained and enhanced through sequential managerial strategies to minimize the knowledge vacuum and improve distinctive competency.

2. METHOD

This study was conducted at the National Research and Innovation Agency (BRIN), which is a merger of the National Nuclear Energy Agency (BATAN), the National Aviation and Space Agency (LAPAN), the Indonesian Institute of Sciences (LIPI), Technology Assessment and Application Agency (BPPT), and several ministries. Data were collected through online questionnaires using a 4-point Likert scale (where 1 means strongly disagree and 4 means strongly agree) that measured latent variables. All questions in the questionnaires were adjusted to the current situation of this study. Appendix A presents the indicators for each variable listed in the questionnaires. The selected respondents were scientists belonging to various research units, where the research types were grouped into basic, applied technological, and applied policy (social humanities). The selected respondents were those who met this criterion: have been working for at least three years in BRIN and worked at least three years in the previous organizations before the merger. Initially, there were 419 responses, but only 314 were deemed valid to proceed. The selected period of data collection was from September 2023 to August 2024. After obtaining the respondents' consent, all of them were interviewed through personal reach. Female scientists (71.08%) dominated the respondents' gender, and the majority of research and development (R&D) projects were discontinued after the merger. Table 1 presents the respondents' detailed profile.

Table 1. Respondents' profile

Characteristic	Classification	Percentage (%)
Gender	Female	71.08
	Male	28.92
Job Level	Assistant	22.06
	Junior	15.20
	Senior	48.04
	Principal	14.71
Type of R&D	Basic	42.65
	Applied	57.35
Continuity of R&D	Continued	49.02
	Discontinued	50.98

This study used structural equation modeling (SEM) with Smart-PLS 4.0 to process the data. SEM analyzed the measurement model and structural model. Descriptive analysis preceded the SEM analysis. To analyze the measurement model, confirmatory factor analysis (CFA) was employed to conduct a reliability-validity analysis and a goodness-of-fit test. Model reliability was determined based on these criteria: loading factor must exceed 0.50, *t*-value must be higher than 1.96, and composite ratio (CR) must be 0.70 or higher (Hair et al., 2011). Meanwhile, model validity was determined based on these criteria: average variance extracted (AVE) must be higher than 0.50, and the value of variance inflation factor (VIF) must be lower than 3.30.

3. RESULTS

Table 2 presents the results of the measurement model. There were no indicators excluded from the structural model measurement since all of them were declared valid and reliable. Assessment of the structural model aimed to ascertain the model's fitness. As the results show, this model exhibits a Normed Fit Index (NFI) value of 0.91 (higher than 0.9) and a Standardized Root Mean Square Residual (SRMR) value of 0.07 (lower than 0.08), meaning that the structural model demonstrates a satisfactory overall fitness. This also indicates that the data gathered in this study well aligned with the model.

The *t*-values and loading factors of each path coefficient between variables resulted from hypothesis testing, as shown in Table 3 and Figure 2. Among 10 hypotheses proposed, nine of them (H1, H2, H3, H4, H5, H7, H8, H9, and H10) were accepted since their *t*-values are higher than 1.96. Meanwhile, one hypothesis (H6) was rejected since its *t*-value is lower than 1.96.

Meanwhile, *R*-squared (R^2) explains that the endogenous variable's variance is reflected by the exogenous variable's variance. Suggested *R*-squared values are defined as follows: 0.26 (substantial), 0.13 (moderate), and 0.02 (weak) (Hair Jr et al.,

Table 2. Measurement model results

Construct	Indicator Code	Loading Factor	T-Value	VIF	α	Composite Ratio	Average Variance Extracted
Innovation Process (IPROS)	PI1	0.84	26.19	2.282	0.81	0.83	0.51
	PI2	0.81	23.08	2.148			
	PI3	0.74	13.26	1.739			
	PI4	0.58	7.66	1.667			
	PI5	0.65	8.43	1.747			
	PI6	0.63	8.83	1.285			
Innovation Performance (IPRF)	IPRF1	0.64	6.59	1.199	0.77	0.78	0.54
	IPRF2	0.52	3.92	1.161			
	IPRF3	0.80	13.96	1.463			
	IPRF4	0.68	6.28	1.281			
Managerial Supports (MS)	MS1	0.77	22.59	2.128	0.88	0.89	0.58
	MS2	0.82	26.39	2.605			
	MS3	0.79	23.60	2.152			
	MS4	0.80	39.18	2.408			
	MS5	0.84	39.18	2.826			
	MS6	0.63	12.14	1.723			
	MS7	0.65	9.96	1.472			
Resource and Infrastructure Management (RIM)	RIM1	0.89	28.84	2.482	0.89	0.90	0.82
	RIM2	0.92	68.02	2.737			
	RIM3	0.92	67.37	2.737			
Human Resource Management (HRD)	HRD1	0.63	8.73	1.401	0.78	0.81	0.60
	HRD2	0.83	26.87	1.754			
	HRD3	0.82	27.58	1.653			
	HRD4	0.80	22.93	1.650			
Distinctive Competency (DC)	DC1	0.78	19.98	1.719	0.79	0.80	0.55
	DC2	0.54	6.89	1.188			
	DC3	0.74	18.16	1.761			
	DC4	0.85	29.76	2.695			
	DC5	0.76	16.48	2.096			

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Table 2 (cont.). Measurement model results

Construct	Indicator Code	Loading Factor	T-Value	VIF	α	Composite Ratio	Average Variance Extracted
Explorative-Exploitative Skills (EE)	EE1	0.75	17.98	2.057	0.87	0.89	0.58
	EE2	0.75	18.44	2.021			
	EE3	0.72	25.03	2.158			
	EE4	0.81	25.03	2.399			
	EE5	0.48	4.79	3.290			
	EE6	0.50	5.10	3.012			
	EE7	0.76	20.56	2.175			
	EE8	0.76	16.38	2.487			
	EE9	0.66	9.55	1.831			
Absorptive-Adaptive Capability (AA)	AA1	0.81	25.70	1.796	0.85	0.86	0.63
	AA2	0.74	16.43	1.687			
	AA3	0.79	15.05	1.908			
	AA4	0.83	29.70	2.025			
	AA5	0.77	17.78	1.747			
Knowledge Vacuum (KV)	KV1	0.71	13.03	1.487	0.81	0.82	0.832
	KV2	0.82	25.27	1.864			
	KV3	0.84	34.31	1.951			
	KV4	0.80	21.56	1.654			

Table 3. Hypotheses testing results

Hypothesis	Path Coefficient *)	T-Value	Effect Size (f^2)	Conclusion
H1: MS → RIM	0.76	18.17	1.36	Accepted
H2: RIM → HRD	0.66	13.85	0.76	Accepted
H3: HRD → KV	0.51	9.66	0.35	Accepted
H4: KV → EE	0.44	7.09	0.24	Accepted
H5: KV → AA	0.44	7.31	0.24	Accepted
H6: KV → DC	–0.08	1.37	0.02	Rejected
H7: AA → DC	0.18	1.96	0.03	Accepted
H8: EE → DC	0.66	8.06	0.43	Accepted
H9: DC → IPROS	0.37	4.86	0.16	Accepted
H10: IPROS → IPRF	0.39	6.26	0.18	Accepted
R^2 (AA) = 0.19	R^2 (EE) = 0.20	R^2 (IPRF) = 0.15	R^2 (KV) = 0.26	
R^2 (DC) = 0.59	R^2 (HRD) = 0.43	R^2 (IPROS) = 0.13	R^2 (RIM) = 0.58	

Note: *$p < 0.05$. IPROS = Innovation Process; IPRF = Innovation Performance; MS = Managerial Supports; RIM = Resource and Infrastructure Management; HRD = Human Resource Management; DC = Distinctive Competency; EE = Explorative-Exploitative Skills; AA = Absorptive-Adaptive Capability; KV = Knowledge Vacuum.

2016). As seen in Table 3, all *R*-squared values range from moderate (R^2 – IPROS) to substantial (R^2 – AA, DC, EE, HRD, IPRF, KV, and RIM).

Based on the importance-performance depiction in Figure 3 and Table 4, distinctive competency exhibits the highest performance value (65.43), meaning that it plays a key role in the innovation process. On the other hand, Figure 3 also reveals that several other organizational factors, such as MS, RIM, and HRD, need to be improved since their performance values are lower than the average criterion (55).

Table 4. The variable values of importance-performance in innovation process (IPROS)

Variables	Importance (Total Effects)	Performance
AA	0.07	62.02
DC	0.37	65.43
EE	0.24	55.76
HRD	0.05	52.21
KV	0.11	34.97
MS	0.03	43.82
RIM	0.04	42.41

Note: IPROS = Innovation Process; IPRF = Innovation Performance; MS = Managerial Supports; RIM = Resource and Infrastructure Management; HRD = Human Resource Management; DC = Distinctive Competency; EE = Explorative-Exploitative Skills; AA = Absorptive-Adaptive Capability; KV = Knowledge Vacuum.

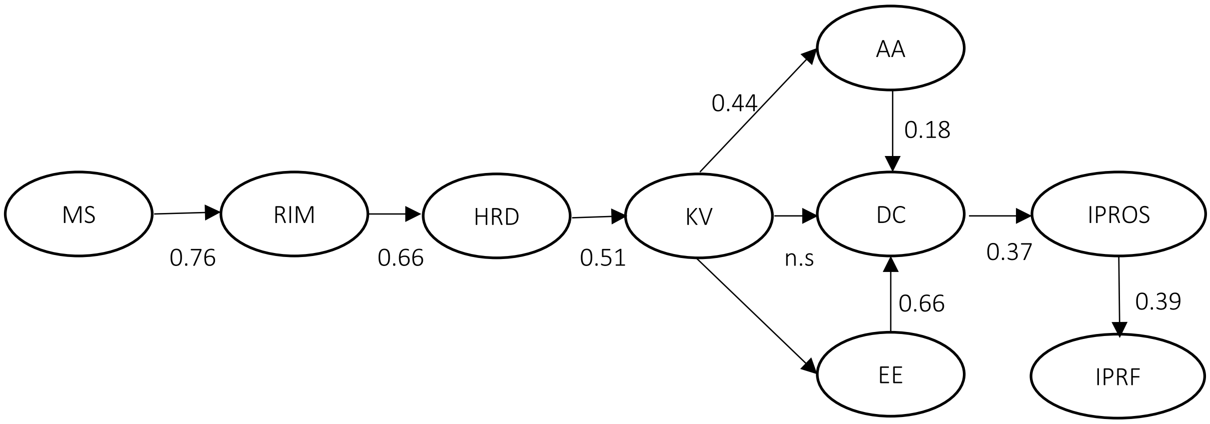

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Figure 2. Path coefficient value in hypotheses framework

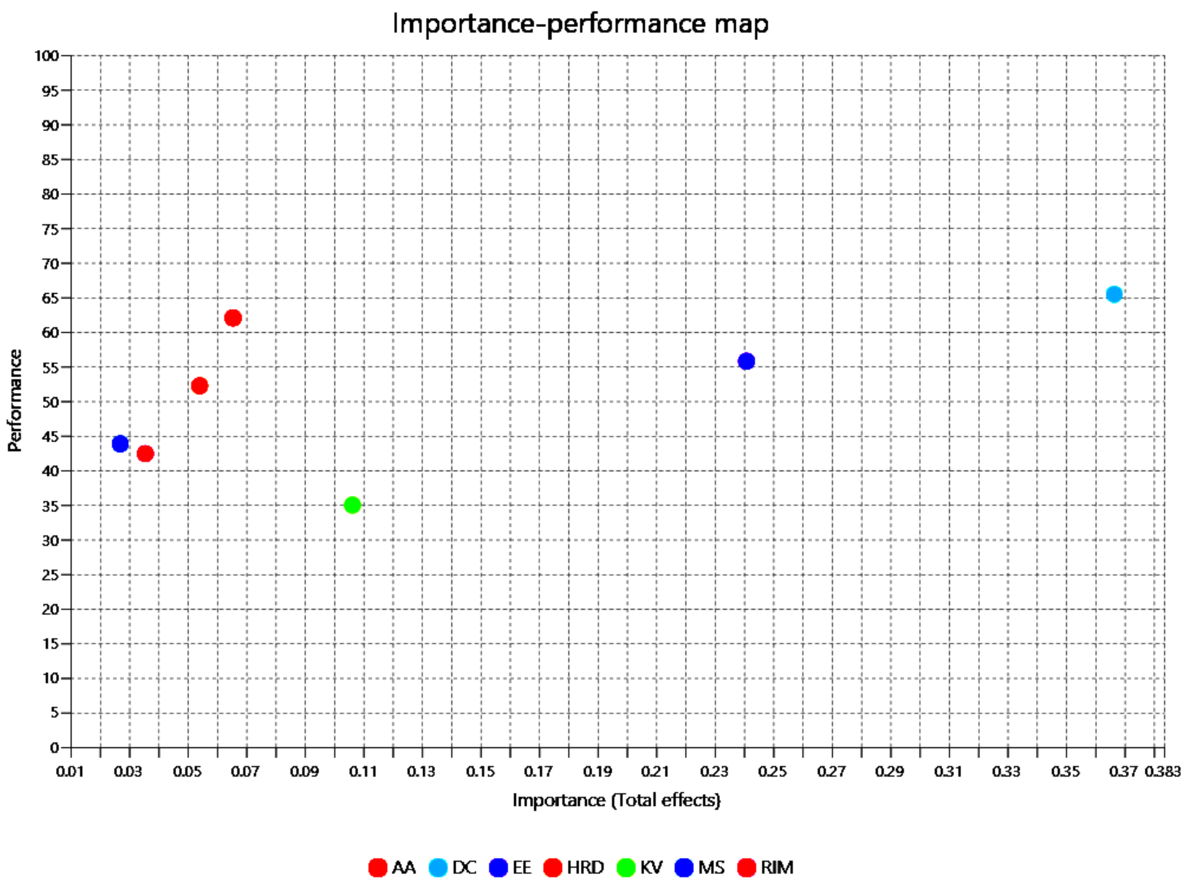

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Figure 3. Importance-performance map of innovation process (IPROS)

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4. DISCUSSION

The first hypothesis (H1) testing reveals that management support has a positive and significant influence on resource and infrastructure management. This finding supports Herranz et al. (2013), who found that management support encourages a work environment by providing the necessary tools and facilities to achieve better performance in a changing environment, as workers are required to practice new behaviors and skills. Moreover, well-committed managerial decisions can result in a fair, even high, performance of research facilities utilization.

The second hypothesis (H2) is confirmed, indicating that resource and infrastructure management have a positive and significant influence on human resource management. This finding aligns with Heller-Schuh et al. (2020), who stated that the distribution and allocation of research facilities also determined the number of skilled scientists that are required to operate certain laboratory equipment. Moreover, the new high-tech research facilities acquired through the merger will encourage scientists to learn and adopt new technologies. This condition will reinforce the emergence of new knowledge and expand the knowledge flow (Symeonidou et al., 2022).

The third hypothesis (H3) testing shows that human resource management has a positive and significant influence on the knowledge vacuum. This finding supported Choi and Chandler (2020), who stated that managing personnel exchange during a merger can induce chaotic events and knowledge loss, especially for research involving advanced technologies. Furthermore, managing scientists' movement during the merger of PRO is often complicated by bureaucratic procedures, which may impede the innovation process.

The fourth hypothesis (H4) testing reveals that the knowledge vacuum has a positive and significant influence on explorative-exploitative skills. This means that scientists will maintain their innovative performance through their networking abilities. Scientist networks can fulfill innovation needs that were lost due to changes in processes and people. However, this finding contradicts previous studies, which stated that knowledge loss negatively affected technological innovation in government offices (Choi & Chandler, 2020; Woon & Pang, 2017).

The fifth hypothesis (H5) testing shows that knowledge vacuum has a positive and significant influence on absorptive-adaptive capability. Despite the dynamic environment during the merger, scientists maintain the work phase within their new work environment. It is not easy for them to move to other public organizations due to the lengthy and complicated administrative procedures. This finding contradicts Dandira (2012), who stated that the knowledge vacuum created negative learning capability, which led to a high turnover.

The sixth hypothesis (H6) testing reveals that the knowledge vacuum has no significant influence on distinctive competency. It was confirmed that a knowledge vacuum can only affect distinctive competency through explorative-exploitative skills and absorptive-adaptive capability. Moreover, this finding also supports Ririh et al. (2023), who stated that the knowledge vacuum did not moderate the relationship between distinctive competency and innovation process.

The seventh hypothesis (H7) testing reveals that absorptive-adaptive capability has a positive and significant influence on distinctive competency. The more capable the scientists are of defining and utilizing knowledge for the strategic innovation process, the more capable they are of performing competent work to create innovative output. Scientists who can easily adapt themselves to new organizational environments will be capable of mastering technological and social knowledge. This finding aligns with several previous studies (Fernandez et al., 2018; Lim & Ok, 2023; Ririh et al., 2023; van Assche et al., 2022).

The eighth hypothesis (H8) testing shows that explorative-exploitative skills have a positive and significant influence on distinctive competency. In addition, explorative-exploitative skills have more significant value than absorptive-adaptive capability. It was confirmed that the capability to adjust oneself to updated knowledge, generate innovation ideas, seek innovation opportunities, enhance innovation knowledge, and execute innovation properly will result in innovation competency, the proof of which includes commercializing innovation outputs and disseminating scientific writings. This finding aligns with Bolívar-Ramos et al. (2012) and Erhan et al. (2024), who revealed that conducting joint research through colleague networking benefits scientists by updating their knowledge of innovation, which can reinforce prototyping skills.

The ninth hypothesis (H9) testing shows that distinctive competency has a positive and significant influence on the innovation process. The same conclusion was also obtained for H10 testing, which examined the relationship between the innovation process and innovation performance. These two hypotheses were confirmed by the innovation performance depiction in Figure 3, signifying that distinctive competency serves as a key factor within the innovation process. This hypothesis is supported by previous studies, which stated that a smooth innovation process enhanced innovation performance by 5% (Colombo & Rabbiosi, 2014; Duan et al., 2022; Sarjono et al., 2024). Moreover, communication ways, facility administration, and standard operational procedures had a significant influence on the innovation process and performance (Cai et al., 2023; Ginting, 2015; Helitha et al., 2023).

CONCLUSION

The study aimed to examine the impact of explorative and exploitative skills on the innovation process and performance during the merger of public research organizations. The results show that explorative and exploitative skills have a stronger impact than absorptive-adaptive capability to distinctive competency. In fact, scientists who experience knowledge loss due to a knowledge vacuum are still capable of maintaining innovation process activities owing to their explorative-exploitative skills, especially networking skills and adaptability to new environments. Management boards can enhance scientists' explorative and exploitative skills by securing commitment to distribute research facilities fairly and conduct training equally for all scientists. Furthermore, the knowledge vacuum has no direct impact on scientists' distinctive competency but rather an indirect impact through explorative-exploitative skills and absorptive-adaptive capability. This suggests that the knowledge vacuum during organizational change serves as a trigger to shape exploratory-exploitative skills, which unintentionally drives the close innovation process toward an open innovation process. Even though a knowledge vacuum can lead to an open innovation process, the organization still needs to lessen its effects to smoothen long-term research activities. Besides, the organizations must also ensure that when the knowledge vacuum during a merger is intended to be minimized, their scientists are equipped with adequate innovation hubs and secure policies of innovation facilities to maintain the innovation process. To expand the research's applicability, future studies are encouraged to evaluate the longitudinal impact of the knowledge vacuum, preferably through a comparative examination of the merger of public and private research organizations.

AUTHOR CONTRIBUTIONS

Conceptualization: Kirana Rukmayuninda Ririh, Machfud, Elisa Anggraeni, Nurul Rochman, Nosica Rizkalla.
Data curation: Kirana Rukmayuninda Ririh, Machfud, Elisa Anggraeni, Nurul Rochman.
Formal analysis: Kirana Rukmayuninda Ririh, Machfud, Elisa Anggraeni, Nurul Rochman, Nosica Rizkalla.
Funding acquisition: Kirana Rukmayuninda Ririh, Machfud, Elisa Anggraeni, Nurul Rochman.
Investigation: Kirana Rukmayuninda Ririh.
Methodology: Kirana Rukmayuninda Ririh, Machfud, Elisa Anggraeni, Nurul Rochman.
Project administration: Kirana Rukmayuninda Ririh.
Resources: Kirana Rukmayuninda Ririh, Machfud, Elisa Anggraeni, Nurul Rochman.
Software: Kirana Rukmayuninda Ririh, Elisa Anggraeni.

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Supervision: Machfud, Elisa Anggraeni, Nurul Rochman.
Validation: Kirana Rukmayuninda Ririh, Machfud, Nurul Rochman, Nosica Rizkalla.
Visualization: Kirana Rukmayuninda Ririh.
Writing – original draft: Kirana Rukmayuninda Ririh, Machfud, Elisa Anggraeni, Nurul Rochman, Nosica Rizkalla.
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APPENDIX A

Table A1. Questionnaire

Variable	Code	Indicator		Source
Innovation Process	IPROS	I am capable of identifying detailed problems and defining conceptual models to make innovations based on the problems that need to be solved.	PI1	Sucupira et al. (2019)
		I am capable of developing conceptual models for innovation purposes.	PI2	
		I am capable of generating the prototype or policy brief from the innovation process that I conduct.	PI3	
		I am open to all suggestions and critiques on the innovation that I perform.	PI4	
		So far, I can improve innovation output based on suggestions and critiques that I received.	PI5	
		As a scientist, I am also capable of commercializing or disseminating innovative output.	PI6	
Innovation Performance	IPRF	I meet the minimum annual target of innovation, at least one patent or scientific paper, or as requested.	IPRF1	Singh et al. (2021)
		I have at least one national or international article publication (or as requested) as the minimum annual innovation output.	IPRF2	
		I fulfill the minimum number of research projects each year, either as a project initiator or as a member.	IPRF3	
		I have completed innovation targets, either as commercialized innovations or as implemented policy briefs.	IPRF4	
Managerial Supports	MS	Management supports scientists through the stimulation of technological skills, either for basic or applied research.	MS1	Stipp et al. (2018)
		Management supports scientific innovation by reinforcing learning organization culture with a valid and reliable knowledge database that can be accessed by all scientists.	MS2	
		Management supports scientists through technical and non-technical training opportunities that are open to all scientists transparently and equally, with the aim of upgrading their knowledge.	MS3	
		Management supports scientists through fair decision-making for innovation without concerning particular parties.	MS4	
		Management commits to short-term, mid-term, and long-term innovation goals and executes them consistently.	MS5	
		Management supports scientists to collaborate with external partners and reinforces a conducive environment for innovation process activities.	MS6	
		Management board provides sufficient facilities and/or infrastructures to support the innovation process.	MS7	
Resource and Infrastructure Management	RIM	Management of resource allocation has been done consistently and carefully by considering scientists' needs.	RIM1	Thelisson (2023)
		Managers committed to implementing resource allocation policy fairly and smoothly.	RIM2	
		Overall, management of resource and infrastructure allocation to support innovation has been well-implemented and without any significant problems.	RIM3	
Human Resource Management	HRD	Human resource management has recruited scientists with a minimum competency of master's or doctoral degree.	HRD1	van Lieshout et al. (2021)
		Human resource management has given training and development of skills openly and equally to all scientists.	HRD2	
		Human resource management has given proper compensations that fit to or exceed targeted innovation performance.	HRD3	
		Performance appraisal has been done periodically by human resource management and has been communicated openly to all scientists.	HRD4	
Distinctive Competency	DC	I am capable of writing national and/or international scientific articles.	DC1	Fernandez et al. (2018)
		I am capable of creating prototypes or policy briefs from the innovation process that I conduct.	DC2	
		I am capable of conducting joint research as targeted by superior	DC3	
		I am capable of thinking logically and critically while conducting an innovation process.	DC4	
		I am capable of updating my technological and social knowledge related to the innovation process that I conduct.	DC5	

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Table A1 (cont.). Questionnaire

Variable	Code	Indicator		Source
Explorative-Exploitative Skills	EE	I can generate product or service innovation ideas through conferences/discussions/networking that I join.	EE1	Ferreira et al. (2021)
		I can take advantage of the opportunity to conduct innovative collaborations through conferences or networking.	EE2	
		I can develop policy briefs or new systems from the innovation process.	EE3	
		I adjust myself to updated technological and non-technical knowledge.	EE4	
		I already delivered innovative output that can be commercialized.	EE5	
		I am able to develop the prototype of innovation using internal and external resources of knowledge.	EE6	
		I can enrich the existing knowledge and diversify the existing innovation types.	EE7	
		I conduct the innovation process in accordance with innovation guidance.	EE8	
		I conduct innovation processes using resources effectively and efficiently.	EE9	
Absorptive-Adaptive Capability	AA	I update innovation knowledge to maximize the innovation process.	AA1	Isip (2022) and Lim and Ok (2023)
		I utilize facilities and infrastructures to enhance the innovation process.	AA2	
		I can define the strategic steps of the innovation process from the beginning until the end.	AA3	
		I can smoothly adapt myself to new, innovative environments.	AA4	
		I learn new technological and social knowledge to support the innovation process that I conduct.	AA5	
Knowledge Vacuum	KV	Due to the merger, there is a loss of persons and business processes.	KV1	Choi and Chandler (2020)
		I feel less motivated after the organizational merger occurred.	KV2	
		There is a loss of knowledge or process due to personnel movement.	KV3	
		Mergers have created inevitable conditions that do not support the organizational learning environment.	KV4	