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Driving Sustainable Asset Performance in Higher Education: The Roles of Governance, Digitalization, and Partnership Capabilities in Indonesia

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Abstract

Effective asset management is critical for university sustainability, yet the mechanisms linking governance and digitalization to asset performance remain unclear, particularly in developing-country higher education. This study investigates how governance and digitalization influence sustainable asset performance in Indonesian public universities, focusing on the mediating role of partnership capabilities and the moderating roles of organizational readiness and environmental dynamism. Survey data were collected from 113 staff involved in asset management, governance, and partnerships across three Indonesian universities. Partial least squares structural equation modeling (PLS-SEM) was employed to test the hypothesized relationships. The results show that partnership capabilities fully mediate the effects of both governance and digitalization on sustainable asset performance. Neither governance nor digitalization exhibits significant direct effects. Organizational readiness moderates the governance-partnership capabilities relationship, while environmental dynamism does not significantly moderate the digitalization-partnership capabilities link. These findings extend dynamic capabilities theory to public university asset management and suggest that universities should prioritize building partnership capabilities, align digitalization investments with collaborative needs, and assess organizational readiness before implementing governance reforms.

Keywords: asset management; governance; digitalization; partnership capabilities; organizational readiness; higher education; Indonesia; sustainable performance

1. Introduction

Universities around the world manage substantial portfolios of physical, financial, and intangible assets. From laboratory equipment and library collections to campus buildings and research facilities, these assets represent significant public investment and are essential for fulfilling teaching, research, and community service missions [1–3]. How well universities govern these assets, leverage digital technologies to manage them, and collaborate with external partners to utilize them has direct consequences for institutional sustainability. Poorly managed assets lead to underutilization, higher operational costs, diminished research capacity, and missed opportunities for community benefit. Conversely, effective asset management can generate revenue, improve efficiency, extend the useful life of infrastructure, and strengthen university-community relationships [4–6].

In Indonesia, these issues carry particular weight. The country's higher education system includes over 2,500 universities serving approximately eight million students, with public institutions operating under the oversight of the Ministry of Education, Culture, Research, and Technology. Since

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the early 2000s, legislative reforms have encouraged Indonesian universities to adopt more autonomous governance structures, pursue international accreditation, and engage with industry and community partners. More recently, the Merdeka Belajar Kampus Merdeka (Independent Learning, Independent Campus) policy has pushed universities to develop external partnerships that allow students to learn outside traditional classroom settings. These policy directions make effective asset management and partnership capabilities more important than ever. Yet many Indonesian universities face persistent constraints: limited budgets, aging infrastructure, uneven staff capacity, and governance systems that were not designed for the current era of autonomy and digital transformation [7–10].

Three concepts have emerged as potentially important for understanding university asset management performance: governance, digitalization, and partnership capabilities. Governance refers to the formal structures—policies, decision-making processes, accountability mechanisms, role defi nitions, and compliance systems—that guide how assets are managed [4,11]. Strong governance is widely assumed to improve organizational outcomes, including asset performance. Digitalization encompasses the use of information technology systems such as enterprise resource planning platforms, real-time monitoring tools, and integrated databases to track, analyze, and manage assets [12–15]. Proponents argue that digitalization enhances transparency, reduces information asymmetries, and enables data-driven decisions. Partnership capabilities, drawing on dynamic capabilities theory [16–19], refer to an organization's ability to coordinate with external partners, manage long-term collaborations, share knowledge and resources across boundaries, align strategic goals, and create mutual value. For universities, these capabilities determine how effectively they can work with industry, government, non-profits, and other educational institutions.

Despite widespread interest in these concepts, the literature reveals several unresolved questions and competing perspectives. The first controversy concerns whether governance and digitalization directly affect performance or operate through intermediary mechanisms. Some studies report direct positive effects of governance on public sector performance [20–22], while others find that governance matters only when accompanied by relational factors such as trust and collaboration [23–25]. Similarly, research on digitalization in public organizations has produced inconsistent results. Meta-analyses suggest that digital government initiatives often fail to deliver expected performance gains unless accompanied by organizational changes and user engagement [26–29]. These mixed findings imply that direct effects models may be misspecified. An alternative view, grounded in dynamic capabilities theory, holds that governance and digitalization are enabling conditions that must be activated through higher-order organizational capabilities—such as the ability to manage partnerships—before they produce performance outcomes [19,30].

A second area of debate concerns the boundary conditions that shape when governance and digitalization are more or less effective. Organizational readiness—the availability of resources, staff skills, internal structures, and preparedness to adopt new systems—may moderate the governance-performance relationship [31–33]. The resource-based view suggests that formal mechanisms work better when organizations already possess the absorptive capacity to implement them. Conversely, governance reforms might be most beneficial precisely when organizations lack readiness, as a way to impose discipline and direction. Empirical evidence on this question is limited and mixed. Environmental dynamism—the rate and unpredictability of change in an organization's external environment—presents a similar uncertainty. Some researchers argue that digitalization becomes more valuable under conditions of high dynamism because digital systems enable faster information processing and adaptive response [34,35]. Others contend that dynamic environments render formal governance and standardized digital systems obsolete, favoring informal, flexible arrangements instead. Which of these perspectives holds true in the university asset management context remains an open empirical question.

A third gap concerns the relative lack of research on these issues in higher education settings, particularly in developing countries. Most studies of university asset management focus on technical aspects: inventory accuracy, maintenance scheduling, space utilization metrics, or financial

 doi:10.20944/preprints202605.0278.v1

depreciation method. Far fewer examine the organizational and relational dimensions of asset performance. Studies that do address governance or digitalization in universities tend to treat these as independent predictors of outcomes without testing mediating mechanisms or moderating conditions. The Indonesian context, with its ongoing governance reforms, digital transformation initiatives, and emphasis on partnership development, offers an opportunity to address these gaps. Understanding how governance, digitalization, and partnership capabilities interact in Indonesian universities could inform policy and practice not only in Indonesia but also in other countries facing similar challenges of resource constraints and institutional transformation.

This study therefore aims to examine how governance and digitalization influence sustainable asset performance in Indonesian universities, with particular attention to the mediating role of partnership capabilities and the moderating roles of organizational readiness and environmental dynamism. Specifically, the study tests seven hypotheses: governance positively affects partnership capabilities (H1); digitalization positively affects partnership capabilities (H2); partnership capabilities positively affect sustainable asset performance (H3); governance directly affects sustainable asset performance (H4); digitalization directly affects sustainable asset performance (H5); partnership capabilities mediate the relationships between governance and sustainable asset performance (H6) and between digitalization and sustainable asset performance (H7); organizational readiness moderates the governance-partnership capabilities relationship (H8); and environmental dynamism moderates the digitalization-partnership capabilities relationship (H9). The research model is presented in Figure 1.

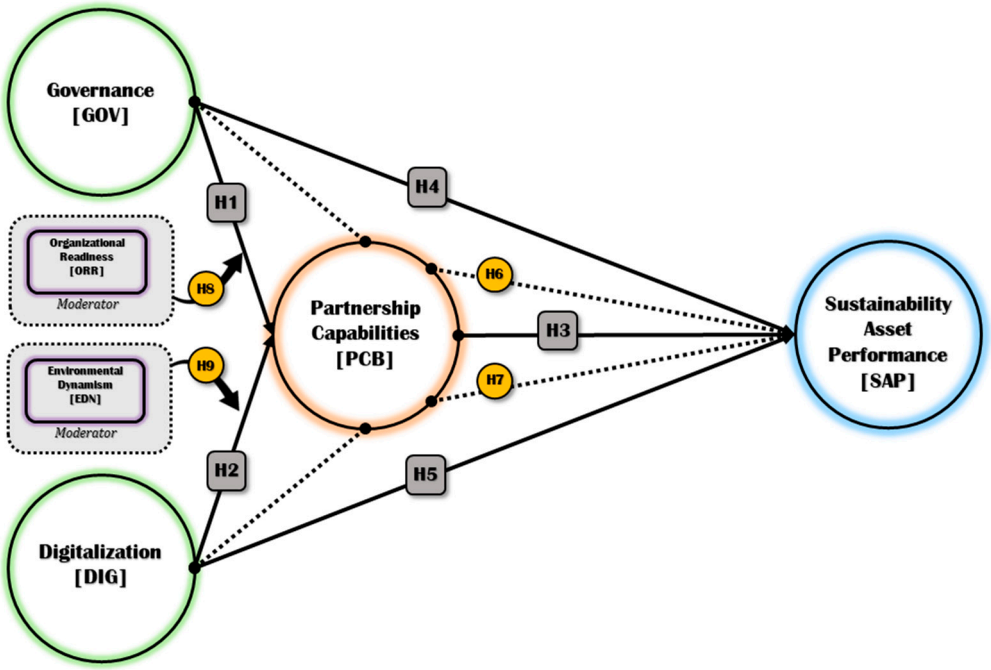

Figure 1. Research model framework.

2. Materials and Methods

2.1. Research Context and Sample

This study focused on Indonesian public universities as the research context. Indonesia's higher education system comprises more than 2,500 institutions serving approximately eight million students, with public universities operating under the coordination of the Ministry of Education, Culture, Research, and Technology. Three universities were selected for participation based on several criteria. First, each institution had implemented formal asset management policies and digital systems for at least three years prior to data collection, ensuring that respondents had adequate

 doi:10.20944/preprints202605.0278.v1

experience with the phenomena under study. Second, each university maintained active partnerships with external organizations, including industry, government agencies, and community groups, making the study of partnership capabilities relevant. Third, the three universities represented different geographic regions and institutional sizes to enhance variability in the sample: Universitas Negeri Padang (UNP) in West Sumatra, Institut Pertanian Bogor (IPB) in West Java, and Universitas Airlangga (UNAIR) in East Java.

Figure 2. Geographical distribution of study locations in Indonesia.

The sampling frame consisted of staff members directly or indirectly involved in asset management, governance, partnership activities, or related administrative functions. These included personnel from asset and facility management units, partnership and collaboration offices, academic departments, administrative divisions, and university leadership. A purposive sampling approach was employed because the phenomena of interest—governance processes, digital system usage, partnership management—required respondents with relevant job responsibilities and institutional knowledge. Potential respondents were identified through each university's organizational directory and contacted via email with an invitation to participate. The invitation explained the study's purpose, assured confidentiality of responses, and provided a link to an online questionnaire. Data collection occurred over an eight-week period between Februari and April 2026.

A total of 189 invitations were distributed across the three universities. Of these, 131 responses were received, yielding a raw response rate of 69.3 percent. After excluding incomplete questionnaires (those with more than 10 percent missing data or patterned responses indicating careless answering), 113 valid responses remained for analysis. This sample size exceeds the minimum recommended for partial least squares structural equation modeling (PLS-SEM) given the model's complexity. Following guidelines proposed by [36,37], a sample size of at least 100 is sufficient for models with up to seven latent variables and five indicators per construct, which applies to the present study.

2.2. Measurement Instruments

All constructs were measured using multi-item scales adapted from prior validated instruments. Each item was rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was originally developed in English, then translated into Indonesian using a forward-backward translation procedure. Two bilingual researchers independently translated the English version into Indonesian. A third researcher reconciled discrepancies between the two translations. The resulting Indonesian version was then back-translated into English by a different bilingual translator who had not seen the original. The back-translated version was compared to the original to identify any semantic or conceptual differences, which were resolved through discussion among the research team. This process ensured linguistic equivalence while preserving the intended meaning of the original items.

 doi:10.20944/preprints202605.0278.v1

Governance (GOV) was measured using five items adapted from governance literature [38–41]. The items assessed the presence of clear policies for asset management (GOV1), transparency in decision-making processes (GOV2), established accountability mechanisms (GOV3), clearly defined roles and responsibilities (GOV4), and compliance with regulations (GOV5). Prior studies have reported Cronbach's alpha values above 0.80 for this scale, indicating adequate internal consistency.

Digitalization (DIG) was measured using five items adapted from digital governance and e-government research [42–46]. The items assessed the use of digital systems to monitor asset utilization (DIG1), integration of asset management processes through digital platforms such as ERP systems (DIG2), availability of real-time data for decision-making (DIG3), efficiency improvements from digital technologies (DIG4), and ease of access to asset usage information through digital systems (DIG5). This scale has demonstrated composite reliability above 0.85 in previous studies conducted in public sector contexts.

Partnership Capabilities (PCB) was measured using five items adapted from dynamic capabilities literature [47–50] and modified for the higher education context. The items assessed effective coordination with external partners (PCB1), capability to manage long-term partnerships (PCB2), effective sharing of knowledge and resources with partners (PCB3), ability to align institutional goals with those of external partners (PCB4), and creation of mutual value through partnerships (PCB5). Initial validation studies reported average variance extracted values exceeding 0.60 for this construct.

Organizational Readiness (ORR) was measured using four items adapted from resource-based view literature [51–54]. The items assessed sufficiency of resources to support partnerships (ORR1), staff skills necessary to manage collaborations (ORR2), organizational preparedness to adopt new systems and processes (ORR3), and internal structures supporting effective collaboration with external partners (ORR4). Prior research has supported the convergent and discriminant validity of this scale.

Environmental Dynamism (EDN) was measured using four items adapted from environmental dynamism research [55–57]. The items assessed the rapidity of change in the university's external environment (EDN1), uncertainty in the institutional environment (EDN2), frequency of changes in market and stakeholder demands (EDN3), and the institution's need to continuously adapt to external changes (EDN4). This scale has been used extensively in studies of organizational adaptation and strategic management.

Sustainable Asset Performance (SAP) was measured using five items adapted from sustainability performance literature [58–62]. The items assessed contribution of asset utilization to increasing institutional revenue (SAP1), improvement of operational efficiency through asset management (SAP2), provision of benefits to the wider community from institutional assets (SAP3), environmental and social responsibility of asset management practices (SAP4), and support for long-term institutional sustainability from asset performance (SAP5). This multi-dimensional approach captures economic, operational, and social-environmental aspects of asset performance.

After data collection, an initial measurement model assessment revealed that two items exhibited factor loadings below the recommended threshold of 0.70. GOV5 loaded at 0.654, and SAP5 loaded at 0.579. Following standard practice in PLS-SEM, these items were removed from further analysis. The remaining four governance items (GOV1-GOV4) and four sustainable asset performance items (SAP1-SAP4) were retained. Table 1 presents the final measurement items, including their codes, statements, and original sources or adaptations.

Table 1. Measurement items.

Construct	Code	Statement	Reference / Adaptation
Governance (GOV)	GOV1	The university has clear policies for managing institutional assets.	Adapted from governance literature
	GOV2	Decision-making processes related to asset management are transparent.	
	GOV3	Accountability mechanisms in asset management are well established.	
	GOV4	Roles and responsibilities in asset management are clearly defined.	

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	GOV5	The institution ensures compliance with regulations in managing assets.	
Digitalization (DIG)	DIG1	The university uses digital systems to monitor asset utilization.	Adapted from digital governance
	DIG2	Asset management processes are integrated through digital platforms (e.g., ERP).	
	DIG3	Real-time data is available for decision-making in asset management.	
	DIG4	Digital technologies improve efficiency in managing institutional assets.	
	DIG5	Information related to asset usage is easily accessible through digital systems.	
Partnership Capabilities (PCB)	PCB1	The university effectively coordinates with external partners.	Adapted from dynamic capability
	PCB2	The institution is capable of managing long-term partnerships.	
	PCB3	Knowledge and resources are effectively shared with partners.	
	PCB4	The university can align its goals with those of external partners.	
	PCB5	The institution creates mutual value through partnerships.	
Organizational Readiness (ORR)	ORR1	The institution has sufficient resources to support partnerships.	Adapted from RBV
	ORR2	Staff have the necessary skills to manage collaborations.	
	ORR3	The organization is prepared to adopt new systems and processes.	
	ORR4	Internal structures support effective collaboration with external partners.	
Environmental Dynamism (EDN)	EDN1	The external environment of the university changes rapidly.	Adapted from environmental dynamism
	EDN2	There is high uncertainty in the institutional environment.	
	EDN3	Market and stakeholder demands frequently change.	
	EDN4	The institution must continuously adapt to external changes.	
Sustainable Asset Performance (SAP)	SAP1	Asset utilization contributes to increasing institutional revenue.	Adapted from sustainability performance
	SAP2	Asset management improves operational efficiency.	
	SAP3	Institutional assets provide benefits to the wider community.	
	SAP4	Asset management practices are environmentally and socially responsible.	
	SAP5	Asset performance supports the long-term sustainability of the institution.	

2.4. Data Analysis Procedures

Data analysis proceeded in three stages (see Figure 3). All analyses were conducted using SmartPLS 4.0 software, which implements partial least squares structural equation modeling (PLS-SEM). PLS-SEM was selected for several reasons. First, the study's research model includes both mediation and moderation effects, which PLS-SEM accommodates well. Second, PLS-SEM is appropriate for predictive-oriented research and does not require multivariate normality assumptions. Third, the sample size of 113 is adequate for PLS-SEM given the model's complexity.

Stage 1: Measurement Model Assessment. The measurement model was evaluated for indicator reliability, internal consistency, convergent validity, and discriminant validity. Indicator reliability was assessed by examining outer loadings, with values of 0.70 or higher considered acceptable. Internal consistency was assessed using Cronbach's alpha and composite reliability (CR), with thresholds of 0.70 for both. Convergent validity was evaluated using average variance extracted (AVE), with values of 0.50 or higher indicating that a construct explains more than half of the variance in its indicators. Discriminant validity was assessed using the heterotrait-monotrait (HTMT) ratio of correlations, with values below 0.85 indicating adequate discriminant validity.

Stage 2: Structural Model Assessment. The structural model was evaluated by examining path coefficients, t-statistics, p-values, and confidence intervals. Path significance was determined using bootstrapping with 5,000 resample. The coefficient of determination (R^2) was used to assess the model's explanatory power, with values of 0.25, 0.50, and 0.75 considered weak, moderate, and substantial, respectively. Effect sizes (f^2) were calculated to assess the magnitude of each predictor's contribution, with values of 0.02, 0.15, and 0.35 considered small, medium, and large effects. The predictive relevance (Q^2) was examined using the blindfolding procedure, with values greater than zero indicating that the model has predictive relevance for a particular dependent construct.

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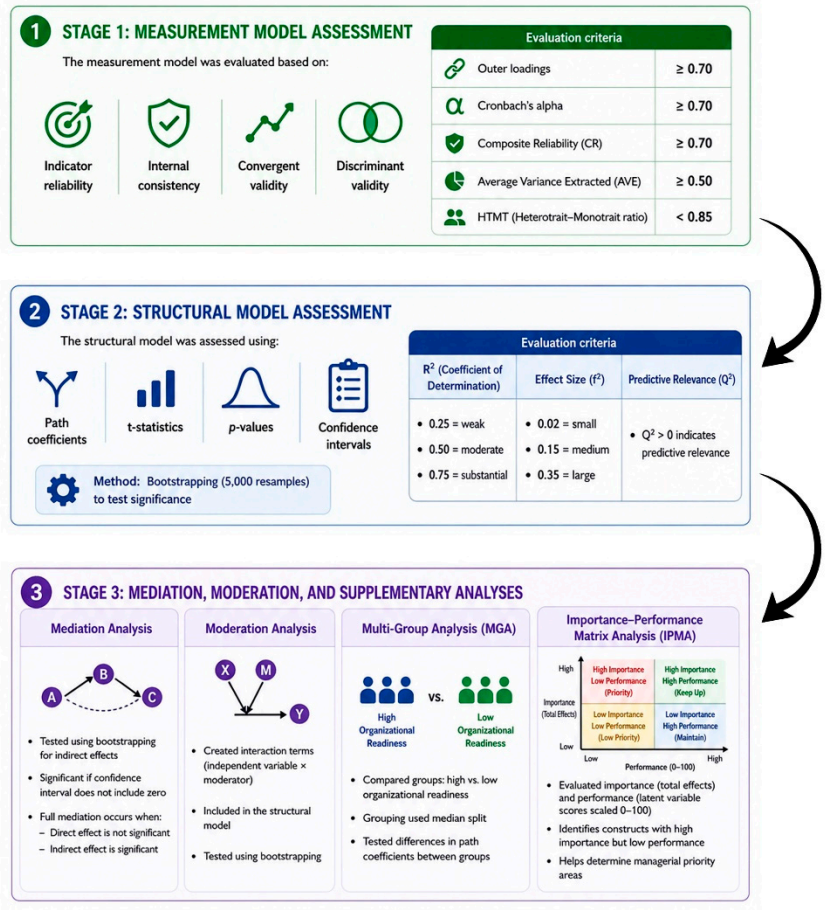

Figure 3. Data analysis procedures.

Stage 3: Mediation, Moderation, and Supplementary Analyses. Mediation effects were tested using the bootstrapping procedure to estimate indirect effects and their confidence intervals. Mediation was considered significant if the confidence interval for the indirect effect excluded zero. Full mediation was indicated when the direct effect was non-significant but the indirect effect was significant. Moderation effects were tested by creating interaction terms between the moderator variable and the independent variable. The interaction term was included in the structural model, and its significance was assessed using bootstrapping. A multi-group analysis (MGA) was conducted to compare path coefficients between groups defined by high versus low organizational readiness, using median split to create the groups. The MGA procedure implemented in SmartPLS 4.0 tests whether the difference in path coefficients between two groups is statistically significant. Finally, an importance-performance matrix analysis (IPMA) was conducted. IPMA extends the standard PLS-SEM results by considering both the importance (total effects) and performance (average latent variable scores, rescaled to 0-100) of each antecedent construct. This analysis helps identify constructs that have high importance for the target dependent variable but low performance, indicating priority areas for management attention.

2.5. Ethical Considerations

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Prior to data collection, ethical approval was obtained from the institutional review board of the lead author's university. All participants were provided with an information sheet explaining the study's purpose, the voluntary nature of participation, the confidentiality of responses, and their right to withdraw at any time without consequence. Informed consent was obtained from all participants before they completed the questionnaire. No personally identifiable information was

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collected, and all data were stored on a secure server accessible only to the research team. The study did not involve any experimental interventions or vulnerable populations.

3. Results

3.1. Respondent Profile

The demographic characteristics of the 113 respondents are summarized in Table 2. Looking at gender, male participants made up 58% (n=66) while female participants accounted for 42% (n=47). This distribution reflects the general composition of staff in Indonesian universities, where administrative and asset management roles are still predominantly held by men. In terms of age, the largest group was those between 30 and 39 years old, representing 37% of the sample (n=42). This was followed by respondents aged 40-49 years (27%, n=30), then those 50 years and above (19%, n=21), and finally those under 30 years (18%, n=20). The relatively young to middle-aged profile makes sense given that digitalization and partnership management require familiarity with current systems and networking activities.

Educational background shows that half of the respondents (50%, n=57) held a master's degree. Bachelor's and doctoral degrees each accounted for 25% (n=28 each). This high level of education is expected because university staff involved in governance and asset decisions typically hold advanced degrees.

Table 2. Respondent demographics (n = 113).

Category		Frequency (n)	Percentage (%)
Gender	Male	66	58%
	Female	47	42%
Age	< 30 years	20	18%
	30–39 years	42	37%
	40–49 years	30	27%
	≥ 50 years	21	19%
Education Level	Bachelor's Degree	28	25%
	Master's Degree	57	50%
	Doctoral Degree	28	25%
Position	Asset/Facility Management	15	13%
	Partnership/Collaboration Unit	12	11%
	Academic Staff	38	34%
	Administrative Staff	28	25%
	Management	20	18%
Work Experience	< 5 years	23	20%
	5–10 years	37	33%
	11–15 years	28	25%
	> 15 years	25	22%
Institution (University)	Universitas Negeri Padang (UNP)	75	66%
	Institut Pertanian Bogor (IPB)	20	18%
	Universitas Airlangga (UNAIR)	18	16%

Regarding job positions, academic staff formed the largest group at 34% (n=38), followed by administrative staff at 25% (n=28), management at 18% (n=20), asset/facility management at 13% (n=15), and partnership unit staff at 11% (n=12). The dominance of academic staff is worth noting

 doi:10.20944/preprints202605.0278.v1

because they are end-users of university assets, but not necessarily the ones making governance decisions.

Work experience was fairly evenly distributed. Those with 5-10 years of experience made up 33% (n=37), followed by 11-15 years at 25% (n=28), more than 15 years at 22% (n=25), and less than 5 years at 20% (n=23). This balance suggests that the respondents had enough experience to provide meaningful answers about institutional practices.

Finally, most respondents came from Universitas Negeri Padang (66%, n=75), while Institut Pertanian Bogor contributed 18% (n=20) and Universitas Airlangga 16% (n=18). The heavier representation from UNP means the findings may lean more toward the context of that institution.

3.2. Measurement Model Assessment

Before testing the hypotheses, the measurement model was evaluated for indicator reliability, internal consistency, convergent validity, and discriminant validity. Figure 4 presents the outer loadings after deleting GOV5, which was removed due to its marginal loading (0.654) in the initial analysis. All remaining indicators had loadings above the recommended threshold of 0.70. For the governance construct, GOV3 had the highest loading at 0.867, followed by GOV1 at 0.812, GOV2 at 0.745, and GOV4 at 0.731. These values indicate that the four governance items adequately captured the essence of institutional governance in the context of asset management.

For digitalization, all five items performed well. DIG3 had the strongest loading at 0.879, followed by DIG5 at 0.856, DIG1 at 0.823, DIG2 at 0.761, and DIG4 at 0.742. This suggests that real-time data availability (DIG3) and easy access to asset information (DIG5) were the most central aspects of digitalization in these universities. Partnership capabilities showed excellent loadings, with PCB4 at 0.901, PCB3 at 0.888, PCB5 at 0.865, PCB1 at 0.834, and PCB2 at 0.772. The high loading for PCB4 (ability to align goals with partners) indicates that strategic alignment is a key component of partnership capability in higher education settings.

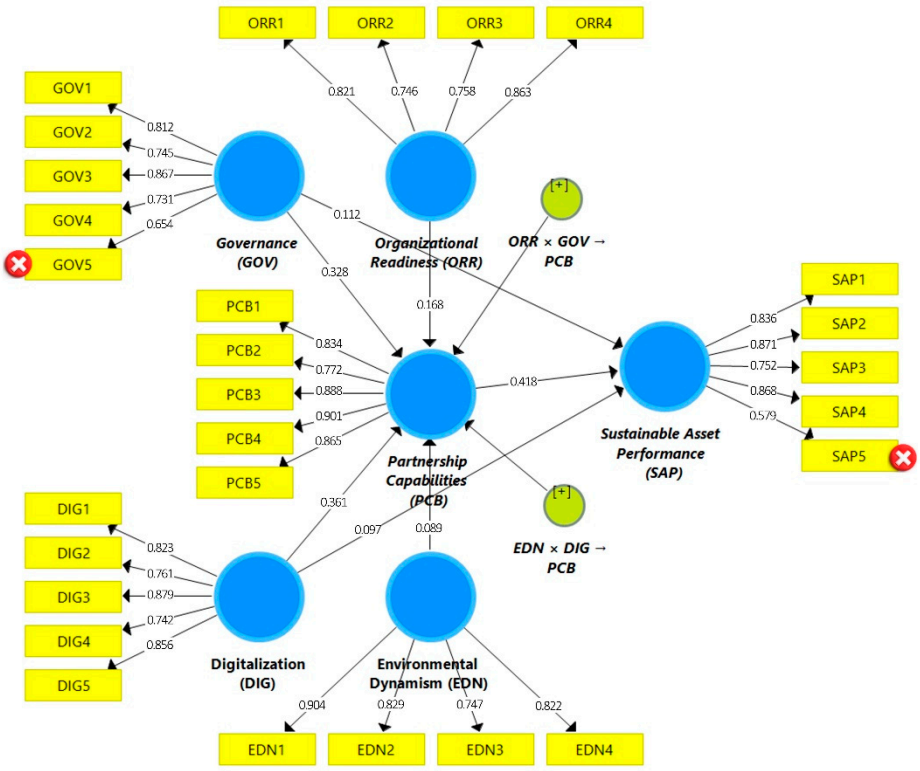

Figure 4. Outer loading.

Organizational readiness items were also solid, with ORR4 at 0.863, ORR1 at 0.821, ORR3 at 0.758, and ORR2 at 0.746. The strong performance of ORR4 (internal structures support collaboration)

 doi:10.20944/preprints202605.0278.v1

highlights the importance of structural readiness for effective partnerships. Environmental dynamism had loadings ranging from 0.747 to 0.904, with EDN1 (environment changes rapidly) being the strongest at 0.904. This suggests that perceived environmental turbulence is well captured by this item. For sustainable asset performance, after removing SAP5 due to its low loading (0.579), the remaining four items (SAP1, SAP2, SAP3, and SAP4) demonstrated satisfactory loadings ranging from 0.752 to 0.879, indicating adequate indicator reliability.

Figure 3 reports the internal consistency and convergent validity of the constructs. Cronbach's alpha values ranged from 0.836 for environmental dynamism to 0.901 for partnership capabilities, all exceeding the conventional cutoff of 0.70. Composite reliability (CR) values were even higher, ranging from 0.891 to 0.927, confirming that the constructs were reliably measured.

Table 3. Construct realibility and validity.

Construct	Cronbach's Alpha	rho_A	CR	AVE
Governance (GOV)	0.864	0.872	0.903	0.651
Digitalization (DIG)	0.887	0.893	0.917	0.689
Partnership Capabilities (PCB)	0.901	0.905	0.927	0.717
Organizational Readiness (ORR)	0.852	0.86	0.9	0.692
Environmental Dynamism (EDN)	0.836	0.842	0.891	0.673
Sustainable Asset Performance (SAP)	0.841	0.848	0.894	0.632

The average variance extracted (AVE) for each construct ranged from 0.632 for sustainable asset performance to 0.717 for partnership capabilities. All AVE values exceeded the 0.50 threshold, meaning each construct explained more than half of the variance in its indicators. Partnership capabilities had the highest AVE at 0.717, indicating very strong convergent validity. Discriminant validity was assessed using the Heterotrait-Monotrait (HTMT) ratio of correlations, shown in Figure 5. This criterion is more stringent than the Fornell-Larcker approach and is recommended in recent methodological literature.

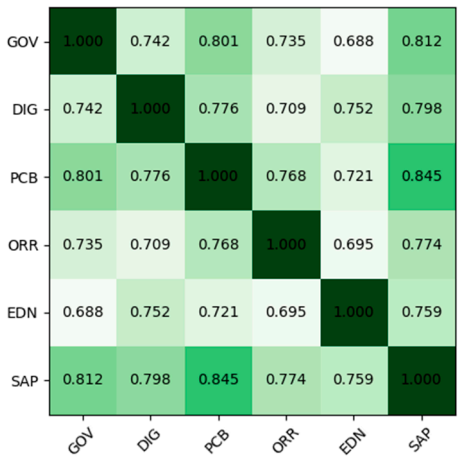

Figure 5. HTMT heatmap.

All HTMT values were below the conservative threshold of 0.85. The highest value was 0.845 between partnership capabilities and sustainable asset performance, which is just under the cutoff. This close value makes theoretical sense because partnership capabilities are expected to be strongly related to performance outcomes. The GOV-SAP correlation was 0.812, also acceptable. No discriminant validity issues were detected.

Multicollinearity was examined using variance inflation factor (VIF) scores, presented in Figure 6. All VIF values were below the common threshold of 5, and most were under 3.5. The highest VIF

 doi:10.20944/preprints202605.0278.v1

was 4.14 for PCB3, followed by 3.58 for PCB5 and 3.52 for APF3. These values are still within acceptable limits, indicating that multicollinearity is unlikely to distort the path coefficients.

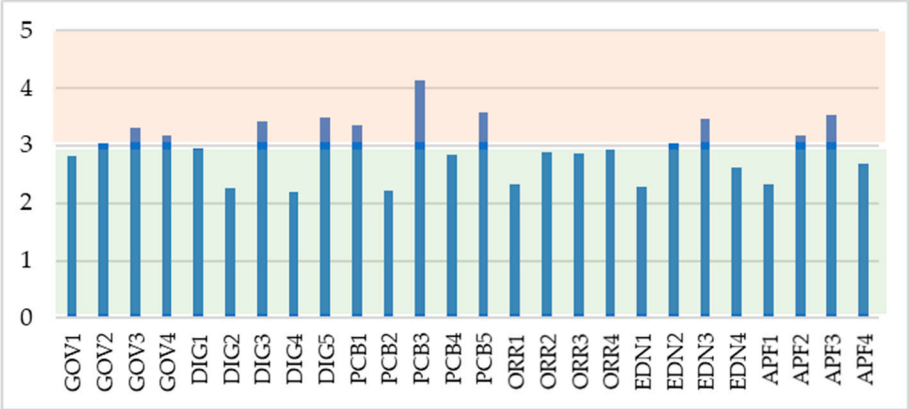

Figure 6. VIF results.

3.3. Structural Model and Hypothesis Testing

The structural model was then estimated using bootstrapping with 5,000 resamples. Table 4 summarizes the path coefficients, t-statistics, p-values, and hypothesis testing results. Starting with the direct effects, Hypothesis H1 proposed that governance positively affects partnership capabilities. The path coefficient was 0.328 with a t-statistic of 3.287 ($p = 0.001$). This finding supports H1. In practical terms, universities with clearer policies and transparent decision-making processes tend to develop stronger capabilities for managing partnerships.

Table 4. Path coefficients.

Hyp.	Path	Original Sample (O)	T Statistics	P Values	Significance	Interpretation
			Direct Effects			
H1	GOV → PCB	0.328	3.287	0.001	Significant	Supported
H2	DIG → PCB	0.361	3.954	0	Significant	Supported
H3	PCB → SAP	0.418	4.812	0	Significant	Supported
H4	GOV → SAP	0.112	1.321	0.187	Not Significant	Not Supported
H5	DIG → SAP	0.097	1.145	0.253	Not Significant	Not Supported
			Mediation Effect			
H6	GOV → PCB → SAP	0.137	2.742	0.006	Significant	Supported
H7	DIG → PCB → SAP	0.151	2.986	0.003	Significant	Supported
			Moderation Effect			
H8	ORR × GOV → PCB	0.168	2.105	0.035	Significant	Supported
H9	EDN × DIG → PCB	0.089	1.412	0.158	Not Significant	Not Supported

Hypothesis H2 stated that digitalization positively affects partnership capabilities. The result shows a coefficient of 0.361 ($t = 3.954$, $p < 0.001$), supporting H2. The effect size is slightly larger than that of governance, suggesting that digital systems and real-time data availability matter slightly more than governance structures for building partnership capabilities. Hypothesis H3 proposed that partnership capabilities positively affect sustainable asset performance. This path had the strongest direct effect among all tested, with a coefficient of 0.418 ($t = 4.812$, $p < 0.001$). The finding supports H3

 doi:10.20944/preprints202605.0278.v1

and indicates that the ability to coordinate with external partners, share knowledge, and align goals is crucial for achieving sustainable outcomes from institutional assets.

Hypothesis H4, which predicted a direct effect of governance on sustainable asset performance, was not supported. The path coefficient was only 0.112 (t = 1.321, p = 0.187). This suggests that governance alone does not directly improve asset performance; instead, its influence appears to work through other mechanisms. Similarly, Hypothesis H5 (direct effect of digitalization on sustainable asset performance) was also not supported. The coefficient was 0.097 (t = 1.145, p = 0.253). Having digital systems in place, by itself, does not automatically lead to better asset performance. This finding aligns with the idea that technology is an enabler, not a direct driver of outcomes.

3.4. Mediation Effects

Given that the direct paths from governance and digitalization to asset performance were not significant, mediation was tested. Hypothesis H6 proposed that partnership capabilities mediate the relationship between governance and sustainable asset performance. The indirect effect was 0.137 with a t-statistic of 2.742 (p = 0.006), confirming full mediation.

What this means is that governance affects asset performance only through its influence on partnership capabilities. In plain terms, having good policies and accountability mechanisms is not enough. Those governance features must first translate into better collaboration with external partners before they can improve how assets perform sustainably.

Hypothesis H7 proposed that partnership capabilities mediate the relationship between digitalization and sustainable asset performance. The indirect effect was 0.151 (t = 2.986, p = 0.003), also supporting full mediation. Digitalization alone does not boost asset performance. It only matters when it helps the university work better with partners.

These mediation results are important because they explain why the direct effects in H4 and H5 were not significant. Governance and digitalization are not directly productive; they are enabling factors that work through partnership capabilities.

3.5. Moderation Effects

Two moderation hypotheses were tested using interaction terms. Hypothesis H8 proposed that organizational readiness moderates the governance–partnership capabilities relationship. The interaction term (ORR × GOV → PCB) had a coefficient of 0.168 (t = 2.105, p = 0.035), supporting H8.

This finding indicates that the effect of governance on partnership capabilities is stronger when the institution is ready in terms of resources, staff skills, and internal structures. For universities with low organizational readiness, even good governance may fail to develop strong partnership capabilities.

Hypothesis H9 proposed that environmental dynamism moderates the digitalization–partnership capabilities relationship. However, the interaction term (EDN × DIG → PCB) was not significant, with a coefficient of 0.089 (t = 1.412, p = 0.158). This means that whether the external environment is stable or rapidly changing, the effect of digitalization on partnership capabilities remains more or less the same.

One possible explanation is that digitalization is already a response to environmental dynamism. In other words, universities that adopt digital systems do so precisely because they face uncertainty, so the moderating effect becomes less visible.

3.6. Coefficient of Determination and Effect Sizes

Partnership capabilities had an R^2 of 0.563 (adjusted R^2 = 0.548), meaning that governance, digitalization, and the interaction terms collectively explained 56.3% of the variance in partnership capabilities. This is considered moderate and practically meaningful (see Table 5).

Table 5. Coefficient of determination (R^2).

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Dependent Variable	R^2	Adjusted R^2	Interpretation
Partnership Capabilities (PCB)	0.563	0.548	Moderate
Sustainable Asset Performance (SAP)	0.482	0.465	Moderate

Sustainable asset performance had an R^2 of 0.482 (adjusted R^2 = 0.465). The four predictors (governance, digitalization, partnership capabilities, and moderators) explained 48.2% of the variance in asset performance. Again, this falls in the moderate range. It also suggests that about half of what drives sustainable asset performance is captured by the model, leaving room for other factors not included in this study.

Table 6. Effect size (f^2).

Relationship	f^2	Interpretation
GOV → PCB	0.128	Small
DIG → PCB	0.162	Medium
PCB → SAP	0.214	Medium
GOV → SAP	0.018	Small (negligible)
DIG → SAP	0.015	Small (negligible)
ORR × GOV → PCB	0.042	Small
EDN × DIG → PCB	0.021	Small

Effect sizes (f^2) are displayed in Table 6. The effect of partnership capabilities on asset performance was medium at 0.214, meaning this relationship has practical significance. Digitalization on partnership capabilities also showed a medium effect at 0.162. Governance on partnership capabilities had a small effect at 0.128. The remaining paths (GOV → SAP, DIG → SAP, and both interaction terms) had negligible effect sizes below 0.05.

3.7. Multi-Group Analysis

A multi-group analysis was conducted to see whether the path coefficients differed between universities with high versus low organizational readiness. A median split was used to create two groups: high ORR (n = 57) and low ORR (n = 56). Only one path showed a significant difference between the two groups. The effect of governance on partnership capabilities was 0.381 in the high ORR group versus 0.254 in the low ORR group, with a difference of 0.127 (p = 0.041). This confirms that organizational readiness strengthens the governance–partnership capabilities link, consistent with the moderation finding in H8 (see Table 7).

Table 7. Multi-Group Analysis (MGA) results using organizational readiness as grouping.

Path	High ORR (n = 57)	Low ORR (n = 56)	Difference	p-value	Result
GOV → PCB	0.381	0.254	0.127	0.041	Significant Difference
DIG → PCB	0.342	0.331	0.011	0.782	No Difference
PCB → SAP	0.436	0.395	0.041	0.318	No Difference
GOV → SAP	0.128	0.097	0.031	0.521	No Difference
DIG → SAP	0.104	0.089	0.015	0.677	No Difference

For all other paths — DIG → PCB, PCB → SAP, GOV → SAP, and DIG → SAP — the differences between groups were small and not statistically significant (p-values ranged from 0.318 to 0.782). This suggests that the model's core structure is relatively stable regardless of how ready the organization is. The only exception is that governance works better in high-readiness settings.

3.8. Importance-Performance Matrix Analysis

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Finally, Figure 7 presents the importance-performance matrix analysis (IPMA). This analysis helps identify which constructs deserve the most management attention by comparing their total effects (importance) with their latent variable scores (performance). Partnership capabilities had the highest importance score at 0.418 and a performance score of 70.2 out of 100. This means that PCB is the strongest driver of sustainable asset performance, and it is already performing relatively well. From a practical standpoint, universities should maintain their current efforts in building partnership capabilities.

Digitalization had an importance score of 0.302 (second highest) but a performance score of only 64.7. This is the most actionable finding from the IPMA. Digitalization is important for achieving asset performance (through PCB), but its current performance level is low. Universities would likely benefit from investing more in digital systems for asset management.

Governance showed medium importance (0.249) and medium performance (68.4). It is not the strongest driver, but it is adequate. No urgent action is needed here, though gradual improvements could still help.

Organizational readiness had lower importance at 0.176 with a performance of 66.8. Environmental dynamism had the lowest importance (0.089) and the lowest performance (62.5). Neither of these constructs is a primary driver of asset performance in this model, so they may not require immediate management attention.

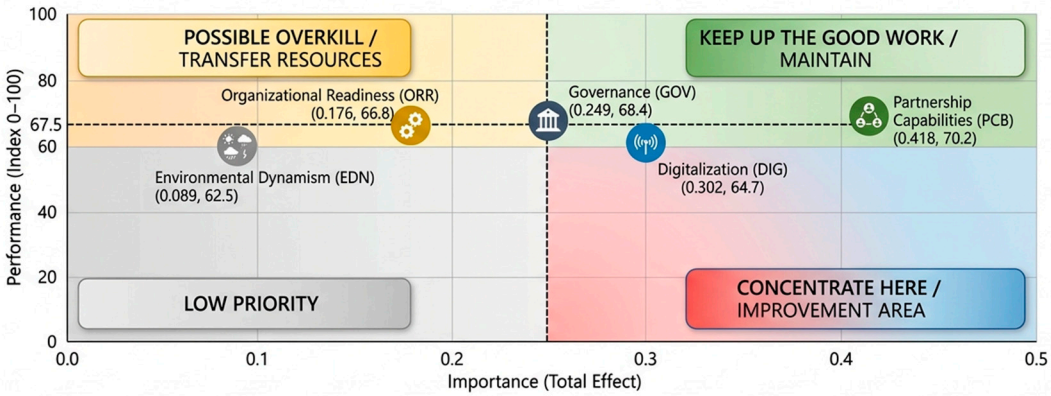

Figure 7. Importance-performance matrix analysis.

4. Discussion

4.1. The Centrality of Partnership Capabilities

The findings point to a clear conclusion: partnership capabilities serve as the primary mechanism linking governance and digitalization to sustainable asset performance. Neither governance nor digitalization exhibited significant direct effects on performance. Instead, their influence passed entirely through partnership capabilities. Several aspects of the results support this interpretation. First, the path from partnership capabilities to sustainable asset performance was the strongest direct effect in the model ($\beta = 0.418$, $p < 0.001$). Second, the indirect effects of governance ($\beta = 0.137$, $p = 0.006$) and digitalization ($\beta = 0.151$, $p = 0.003$) on performance were both significant, while the direct effects were not. This pattern indicates full mediation.

These findings align with dynamic capabilities theory [63–66], which suggests that organizations require higher-order capabilities to transform resources into desired outcomes. In the context of university asset management, partnership capabilities represent such a higher-order capability. Governance structures establish accountability and role clarity. Digital systems provide data integration and real-time monitoring. However, these enablers produce results only when they support effective collaboration with external partners.

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Prior work on public sector asset management has reached similar conclusions [67–70], found that relational competencies often outweigh formal controls in determining performance outcomes. Within higher education specifically, documented that successful university-industry partnerships depend less on contractual arrangements than on the ability to coordinate activities and align goals across organizational boundaries. The present study quantifies this insight by demonstrating that partnership capabilities fully mediate the effects of two major antecedents.

4.2. The Absence of Direct Effects

The non-significant direct effects of governance on sustainable asset performance ($\beta = 0.112$, $p = 0.187$) and digitalization on sustainable asset performance ($\beta = 0.097$, $p = 0.253$) warrant careful consideration. These results might appear counterintuitive, as both governance and digitalization are commonly assumed to drive performance improvements directly.

However, a growing body of evidence suggests that governance and technology function as enablers rather than direct drivers. A study of Indonesian local governments [71–73] found that e-government implementation improved service delivery only when accompanied by changes in inter-agency collaboration and internal processes. Similarly, study [74–76] reported that formal governance mechanisms in university-industry partnerships proved less important than relational governance dimensions such as trust, communication, and joint problem-solving.

The theoretical implication is straightforward. Governance reduces transaction costs and establishes accountability. Digitalization provides information infrastructure for coordination and monitoring. But these benefits must be activated through collaborative activities. A university may maintain well-designed asset policies and sophisticated information systems, yet fail to achieve sustainable asset performance if it cannot coordinate effectively with external partners. The findings suggest that governance and digitalization are necessary but not sufficient conditions for performance.

This interpretation carries a practical implication that should not be overlooked. University administrators who assume that policy reforms or technology investments will automatically improve asset outcomes are likely to be disappointed. These investments require complementary investments in partnership capabilities.

4.3. Organizational Readiness as a Boundary Condition

The moderation hypothesis concerning organizational readiness (H8) received support. The interaction term between organizational readiness and governance in predicting partnership capabilities was significant ($\beta = 0.168$, $p = 0.035$). The multi-group analysis reinforced this finding: the governance-partnership capabilities path coefficient was 0.381 in the high-readiness group compared to 0.254 in the low-readiness group, a difference of 0.127 ($p = 0.041$).

This pattern is consistent with the resource-based view of the firm [77–79]. Organizational resources and capabilities interact with formal structures to produce outcomes. Governance mechanisms are more effective when the organization possesses the absorptive capacity to implement them. A university that lacks skilled personnel or maintains rigid internal structures will struggle to translate governance policies into effective partnerships, regardless of the technical quality of those policies.

It is worth noting that organizational readiness moderated only the governance-partnership capabilities relationship. The effects of digitalization on partnership capabilities, and of partnership capabilities on performance, did not differ significantly between high- and low-readiness groups. This suggests that organizational readiness matters specifically for governance implementation. One possible explanation is that governance requires interpretation and discretionary action by personnel, whereas digital systems impose more standardized processes. When processes are standardized, organizational readiness may matter less.

4.4. The Non-Significant Moderation of Environmental Dynamism

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Hypothesis H9, which proposed that environmental dynamism moderates the digitalization-partnership capabilities relationship, was not supported. The interaction term was non-significant (β = 0.089, p = 0.158). This finding was unexpected given prior research suggesting that digital technologies become more valuable under conditions of environmental turbulence.

Several explanations merit consideration. First, digitalization may be endogenous to environmental dynamism. Universities facing high uncertainty may adopt digital systems precisely because of that uncertainty. Once digitalization is in place, its effect on partnership capabilities may not vary substantially across different levels of environmental dynamism. The descriptive data are consistent with this interpretation: mean environmental dynamism scores across the three universities ranged from 3.8 to 4.2 on a five-point scale, indicating that perceived turbulence is a shared condition rather than a differentiating factor.

Second, partnership capabilities themselves may buffer organizations against environmental dynamism. Universities with strong partnership capabilities may navigate environmental changes effectively regardless of their reliance on digital systems. If partnership capabilities absorb much of the environmental variance, the moderating effect of environmental dynamism on the digitalization-partnership capabilities relationship would be attenuated. Third, measurement issues cannot be ruled out. The study used perceptual measures of environmental dynamism. Objective indicators—such as regulatory change frequency, funding volatility, or competitive pressure—might yield different results. The relationship between environmental dynamism and digitalization effectiveness may also be non-linear, which would not be captured by the linear interaction term specified in the model.

4.5. Theoretical Contributions

This study makes several contributions to the literature. First, it extends dynamic capabilities theory to the context of public university asset management. While dynamic capabilities have been extensively studied in private sector firms, their application to public organizations remains relatively underdeveloped. The findings show that partnership capabilities function as a dynamic capability in the higher education setting, mediating between enabling conditions and performance outcomes. This supports the view that public organizations must develop collaborative capacity to address complex, multi-stakeholder challenges.

Second, the study integrates insights from governance theory, the resource-based view, and digital transformation research within a single empirical framework. The full mediation findings suggest that governance and digitalization are not competing pathways to performance but complementary enablers that operate through a shared mediating mechanism. This integration helps resolve debates in the literature about whether governance or technology matters more for organizational performance. Neither matters directly, but both matter indirectly through partnership capabilities.

Third, the moderation finding for organizational readiness identifies an important boundary condition. The effectiveness of governance depends on the organization's pre-existing resource base and skill set. This aligns with contingency perspectives in organizational design and suggests that one-size-fits-all governance standards may be inappropriate across universities with different levels of organizational readiness.

4.6. Practical Implications

Several practical implications follow from these findings. First, university administrators should prioritize partnership capabilities as a strategic objective. The strong effect of partnership capabilities on sustainable asset performance (β = 0.418) suggests that investments in collaborative capacity are likely to yield returns. Specific actions include training staff in partnership management, establishing dedicated partnership units (only 11 percent of the sample reported having such units), developing protocols for knowledge sharing, and creating mechanisms for goal alignment with external partners.

Second, digitalization should be viewed as an enabler of partnerships rather than an end in itself. The importance-performance matrix analysis revealed that digitalization had high importance (0.302)

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but low performance (64.7). This gap represents an actionable priority. Universities should invest in digital systems that specifically support partnership activities, such as shared data platforms, collaborative project management tools, and asset tracking systems accessible to partners. Implementing enterprise resource planning systems without attention to how they facilitate external collaboration is unlikely to improve sustainable asset performance. Third, governance reforms alone are insufficient. The non-significant direct effect of governance on sustainable asset performance (β = 0.112) and its negligible effect size (f^2 = 0.018) indicate that universities cannot rely on policies and accountability mechanisms alone. When universities revise their asset management policies, they should simultaneously invest in partnership-focused training and support.

Fourth, organizational readiness should be assessed before implementing governance reforms. The moderation finding suggests that governance is more effective in universities with adequate resources, skilled staff, and supportive internal structures. For universities with low organizational readiness, a more effective strategy might involve first investing in foundational capacity—hiring skilled personnel, providing training, streamlining internal processes—before attempting complex governance reforms. Fifth, the importance-performance matrix provides guidance for resource allocation. Partnership capabilities are already performing adequately (70.2) and should be maintained. Digitalization is the most actionable priority because it demonstrates high importance but low performance. Governance is performing adequately (68.4) with medium importance (0.249). Environmental dynamism and organizational readiness show lower importance and are not immediate priorities.

4.7. Limitations

Several limitations should be acknowledged. The cross-sectional design precludes strong causal inferences. The path model is grounded in theory, with governance and digitalization specified as antecedents, partnership capabilities as mediator, and asset performance as outcome. However, reverse causality remains possible. Universities with better asset performance may attract more partners or invest more in digital systems. Longitudinal research tracking universities over time as they implement changes would provide stronger evidence for causal relationships.

The sample size (n = 113) is adequate for partial least squares structural equation modeling but is concentrated in three Indonesian universities, with 66 percent of respondents from a single institution (Universitas Negeri Padang). This concentration raises questions about generalizability. Indonesian higher education has distinctive characteristics—a mix of public and private institutions, regional disparities in funding and capacity, and ongoing governance reforms—that may not reflect conditions in other national contexts. Replication studies in different countries and across different institutional types would strengthen confidence in the findings.

The study relied on self-reported perceptual measures. Although the measurement model demonstrated satisfactory validity, with all average variance extracted values exceeding 0.63 and all heterotrait-monotrait ratios below 0.85, common method variance cannot be completely ruled out. Respondents may have inflated relationships due to consistency biases. Future research could incorporate objective measures such as digital system usage logs, number of active partnerships, asset utilization rates, and financial data.

The model explained 56.3 percent of the variance in partnership capabilities and 48.2 percent of the variance in sustainable asset performance. While these values are moderate and practically meaningful, substantial variance remains unexplained. Other important predictors likely include leadership commitment, organizational culture, government policy and funding regimes and the specific characteristics of university assets (physical assets versus intellectual property versus financial assets). Future research could extend the model to include these variables. The study did not distinguish between different types of partnerships. Universities engage with industry partners, government agencies, other universities, non-profit organizations, and community groups. Each type of partnership may have different governance requirements and performance implications. Future

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research could examine whether the model holds across partnership types or whether specific configurations of governance and digitalization are needed for specific partners.

The non-significant moderation by environmental dynamism warrants further investigation. As noted above, this may reflect measurement issues, non-linear effects, or contextual specificities. Future studies could use more refined measures of environmental dynamism, such as objective indicators of regulatory change, funding volatility, or competitive pressure, or could explore non-linear interaction effects.

4.8. Contextual Considerations

The findings should be interpreted within the Indonesian higher education context. Since the passage of the National Education System Law (No. 20/2003) and the Higher Education Law (No. 12/2012), Indonesian universities have been encouraged to adopt more autonomous governance structures, pursue internationalization, and engage with industry and community partners. The government has also promoted digital transformation through initiatives such as the Indonesia Higher Education Online Learning platform and the integration of university information systems.

However, resource constraints remain a persistent challenge. Many public universities outside Java face limitations in budget, infrastructure, and skilled personnel. This context explains why organizational readiness emerged as a significant moderator. Governance reforms are unlikely to succeed in resource-constrained settings unless accompanied by capacity-building efforts.

The finding that partnership capabilities are the key mediator is also contextually meaningful. Indonesian universities are increasingly expected to contribute to the Merdeka Belajar Kampus Merdeka (Independent Learning, Independent Campus) policy, which encourages students to gain experience outside traditional classrooms through industry internships, community projects, and exchange programs. These initiatives require universities to build robust partnerships with external organizations. Universities that succeed in building partnership capabilities are likely to see improvements in how they manage and utilize their institutional assets.

4.9. Future Research Directions

Beyond addressing the limitations noted above, several future research directions emerge from this study. First, qualitative research could illuminate the mechanisms through which partnership capabilities develop. How do universities actually build these capabilities? What barriers do they encounter? How do successful universities differ from unsuccessful ones? Case studies of high-performing and low-performing universities could provide rich insights that complement the quantitative findings. Second, comparative research across countries could examine how institutional contexts shape the relationships documented here. Do the findings hold in countries with different governance traditions, different levels of digital infrastructure, or different higher education funding models? Cross-national studies would help establish the generalizability of the framework.

Third, intervention studies could test whether targeted efforts to build partnership capabilities actually improve sustainable asset performance. Such studies would provide stronger evidence for causality than cross-sectional designs can offer. Fourth, research could examine the micro-foundations of partnership capabilities. What individual-level skills and competencies aggregate to organizational-level partnership capabilities? How are these skills developed and maintained? Answers to these questions would provide practical guidance for training and development programs. Fifth, the non-significant moderation by environmental dynamism deserves focused attention. Is this finding robust across different operationalizations of environmental dynamism? Does it hold in other contexts? Or does it reflect something specific about Indonesian higher education? Future research could explore these questions using both quantitative and qualitative methods.

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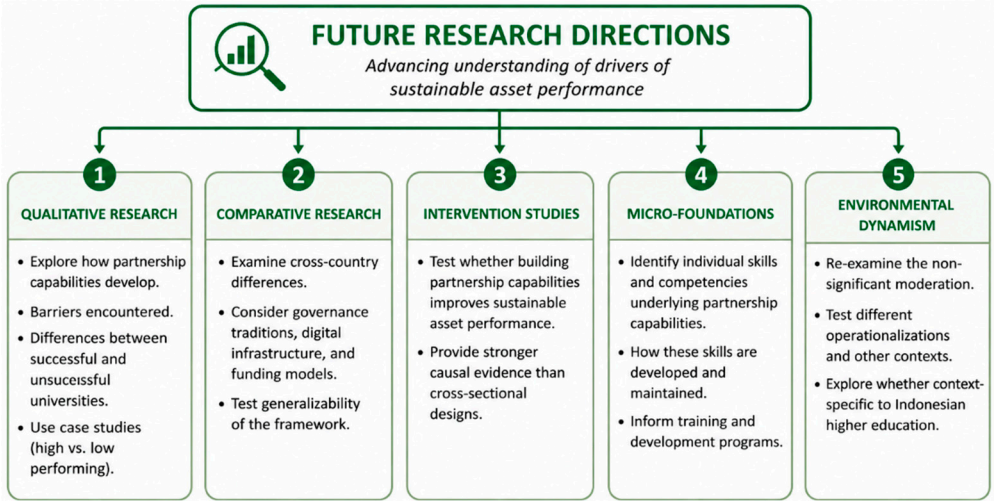

Figure 8. Proposed agenda for future research.

5. Conclusions

This study examined how governance and digitalization influence sustainable asset performance in Indonesian universities, with particular attention to the mediating role of partnership capabilities and the moderating roles of organizational readiness and environmental dynamism. The central finding is that partnership capabilities fully mediate the relationships between governance and sustainable asset performance and between digitalization and sustainable asset performance, meaning that neither governance nor digitalization exhibits significant direct effects on performance; instead, their influence passes entirely through the ability of universities to coordinate with external partners, share knowledge, and align goals. Organizational readiness moderates the governance-partnership capabilities relationship, such that governance reforms are more effective in universities with adequate resources and skilled staff, while environmental dynamism does not significantly moderate the digitalization-partnership capabilities link. The study extends dynamic capabilities theory to the context of public university asset management and offers practical implications for university administrators: prioritize partnership capabilities as a strategic objective, direct digitalization investments toward systems that support external collaboration, ensure that governance reforms are accompanied by partnership development efforts, and assess organizational readiness before implementing complex governance changes. Limitations include the cross-sectional design, sample concentration in three Indonesian universities, reliance on self-reported measures, and unexplained variance in the dependent variables, pointing to future research directions such as longitudinal studies, cross-national comparisons, and qualitative investigations of how partnership capabilities develop.

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Institutional Review Board Statement: Ethical review and approval were waived for this study because it involved no experimental interventions, no vulnerable populations, and only collected anonymous survey data on organizational practices with informed consent obtained from all participants.

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Informed Consent Statement: Informed consent was obtained from all participants involved in the study. All participants were provided with an information sheet explaining the study's purpose, the voluntary nature of participation, the confidentiality of responses, and their right to withdraw at any time without consequence.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to privacy and ethical restrictions. Participants were assured of confidentiality, and individual responses cannot be publicly shared to protect anonymity.

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

Abbreviation	Full Form
AVE	Average Variance Extracted
CR	Composite Reliability
DIG	Digitalization
EDN	Environmental Dynamism
ERP	Enterprise Resource Planning
GOV	Governance
HTMT	Heterotrait-Monotrait Ratio
IPB	Institut Pertanian Bogor
IPMA	Importance-Performance Matrix Analysis
MDPI	Multidisciplinary Digital Publishing Institute
MGA	Multi-Group Analysis
ORR	Organizational Readiness
PCB	Partnership Capabilities
PLS-SEM	Partial Least Squares Structural Equation Modeling
RBV	Resource-Based View
SAP	Sustainable Asset Performance
SEM	Structural Equation Modeling
UNAIR	Universitas Airlangga
UNP	Universitas Negeri Padang
VIF	Variance Inflation Factor

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