

ASSESSMENT OF RESEARCH CAPACITY OF HIGHER EDUCATION INSTITUTIONS IN THE PHILIPPINES

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ABSTRACT

Evaluating research management approaches and identifying strategies that facilitate the achievement of research agenda is critical in strengthening research capacity in Higher Education Institutions (HEIs). This study determines the research readiness of Philippine HEIs. The average national readiness index was found to be at a score of 2.12, where about 53% of all regions in the Philippines fell below. This highlights a pressing gap that needs to be addressed. Statistical analysis indicate that the key determinants of an institution's research capacity include institutional commitment characterized by linkages and partnerships, research collaborations, CHED autonomous status, and having center of excellence/development programs offered in the HEIs. Furthermore, investments in infrastructure and human capital need improvement. Lastly, current research focus is dominantly on the fields of Health and Wellness, Sustainable Communities, and Agricultural Socio-Economic Impacts. Hence, research must also be focused on other priority areas such as clean energy and Industry 4.0.

Keywords: *Research capacity; research readiness; higher education institutions*



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INTRODUCTION

Innovation and research are critical components of technological and economic development. Numerous studies have demonstrated that supporting innovative activities and producing high-quality research outputs increases economic competitiveness (Polyakov & Kovshun, 2021; Shkarlet et al., 2019; Zakharkina et al., 2018). As part of the UNESCO world declaration on higher education for the 21st century, state policies must foster and develop research, which is an essential component of all higher education institutions (HEIs) given their relevance to development (UNESCO, 1998). A competitive economy is the only way to sustain economic growth and boost national production for the people's welfare (Okereafor et al., 2015). As such, innovation supported by higher education research is a vital instrument to strengthen the economic capability of a country which likewise transcends to its ability to address national issues.

The significance of this concern is highlighted by the latest Global Competitiveness Report released by the International Institute for Management Development (IMD) where Philippines ranked 48th out of 63 economies worldwide. Philippines improved by four spots from its ranking of 52nd out of 64 economies in 2021. However, this is still problematic as Philippines ranks low compared to its neighboring countries, garnering the 13th position among 14 Asia-Pacific countries for the past five years. Among the areas which Philippines' performance lags is in improving and creating health and education infrastructure. (Ochave, 2022).

The National Higher Education Research Agenda II outlined three general guiding principles on higher education research: (1) Research is the pinnacle of an individual's innovative and creative abilities; (2) Research thrives in an environment that allows for the open flow of information, the honest and analytical discussion of ideas, and the presence of supportive policy and administrative institutions; and (3) Research is a critical component of higher education (Commission on Higher Education, 2009). Consistent with these guiding principles, the higher education sector must create a conducive academic atmosphere for Filipino researchers. Higher education policies must improve the capacity of institutions and individuals to pursue independent, collaborative, and creative research. Also, discipline-based, policy-oriented, technology-directed, and innovative/creative research is expected especially from universities. These guiding principles support the HEIs to achieve their mission of producing highly skilled workers, generating knowledge and technology, and promoting sustainable development. Improving the research capabilities of our HEIs is then vital to subscribe to these principles.

Strengthening research capacity is a multifaceted topic that has been characterized in a variety of ways. It is defined as any endeavor to improve individuals' and institutions' abilities to do high-quality research and connect with a broader community of stakeholders (ESSENCE on Health Research, 2014). While knowledge transfer and research networks are stimulated by the digital technology revolution, improving the research capacities of HEIs remains to be difficult as it demands a long-term commitment and support from relevant stakeholders. Improving research network and collaboration, assuring local ownership and active research support, and building robust research governance are among the major fundamental elements in strengthening HEI research capability (ESSENCE on Health Research, 2014).

Building research capacity in HEIs necessitates an assessment of research management practices as well as the identification of transitional procedures to promote the evolving research agenda (Huenneke et al., 2017). The purpose of this study is to examine HEIs' capacity to conduct high-quality research. The key indicators of institutional research performance are also investigated. Moreover, the areas of research strength and weakness in terms of HEI capacity are evaluated. Major factors influencing HEIs' research readiness are also assessed. Finally, areas for intervention to strengthen the research capability of HEIs are identified.

Segrott et al. (2006) examines the critical barriers to developing research capacity and the capacity building strategies adopted and proposed within existing literature for nursing academic departments. They identified that research capacity development may be supported or hindered by material constraints, organizational politics, and changing roles and expectations of educators. These include building relevant infrastructure, fostering research cultures and environments, and facilitation of training and collaboration. Additionally, aside from these factors, having an overall strategic approach that is clearly communicated and accompanied by effective leadership are important to strengthening research capacity. Heitor et al. (2013) made use of a dynamic approach to understand the evolutions of human capital (e.g., researchers and doctorates) and research capacity in emerging regions and countries globally. Their findings revealed that public investment in science and technology human capacity and institutional capacity can lead to brain gain. Their research also indicates a critical role played by major, long-term, government funded and centralized program for research doctoral and post-doctoral grants, both under and independent of higher education institutions. Moreover, another policy that improved the incidence of brain gain is to foster research career paths in universities independent of their academic careers to encourage continuous recruitment of young researchers into research units. Cooke (2005) proposed a framework to evaluate research capacity building in health care services, their research highlight principles such as developing skills and confidence, strengthening linkages and partnerships,

ensuring the accuracy of research to practice, developing relevant dissemination efforts and platforms, investing in infrastructure, and ensuring sustainability and continuity. These principles must be operated at individual, team, organizational, and national levels to ensure progress. Similarly, Sawyerr (2004) assert that research capacity would be strengthened by a quality research environment, funding, adequate infrastructure, research incentives, time available to researchers. At the higher education and research institution level, concrete initiatives they may take to develop research capacity include strengthening of graduate studies, improvement of management in research, support for younger faculties, identification, and concentration on areas of strength, and pooling or sharing resources with other teams and institutions.

The OPRKM-Knowledge Management Division of the Commission of Higher Education (2019) published the status of the Philippine Higher System during the academic year (AY) of 2018-2019. There were a total of 1,963 HEIs excluding SUCs Satellite campuses, 88% of these were private, while 242 were public HEIs. From this, 111 were state universities and colleges, including the University of the Philippines.

As of AY 2018-2019, Region XIII or the National Capital Region (NCR) had the most number of total HEIs and second most number of HEIs with Engineering and Technology programs respectively with a total of 339 HEIs and 88 HEIs with Engineering and Technology. NCR is followed by Region 4-CALABARZON with 282 HEIs, but has the most number of HEIs with Engineering and Technology having 108 institutions. Region 3-Central Luzon has the third most HEIs and HEIs with Engineering and Technology, 200 and 73 institutions respectively. It may be noticed across all regions that the gap between the total number of HEIs and HEIs with Engineering and Technology is still wide.

Graduates of AY 2017-2018 totaled to 751,310 students, which is a 6.8% increase from the previous AY, and 49.9% of these graduates were from public institutions. STEM graduates consisted of 274,469 or 38.5% of total graduates, exhibiting a 4.3% from the previous year. Particularly, 109,685 or 11.6% of total graduates were from the field of Engineering and IT-related problems. These are comprised of 108,476 from undergraduate degree programs, 1,154 from Master's programs, and 55 from Doctorate programs. Lastly, the STEAM field had a total of 8,150 faculty with PhD degrees, making up 15.3% of the faculty population. The breakdown of STEAM graduates from AY 2014-2018 by disciplines, across all four academic years, it is notable that the contribution of graduates from technology exceeds that of science, engineering, agriculture, and mathematics. Across all years, the general share of each discipline stays the same.

The total number of HEIs in the Philippines with Center of Excellence (COEs) in Engineering and IT-related programs only equal to 22, which accounts for just about 1.1% of total HEIs. Although Regions 4A, 12, and 3 had the most total number of HEIs, Region 13 or NCR had the greatest number of HEIs with COEs, specifically NCR has 10 HEIs with COEs in Engineering and IT-related programs, followed by 3 HEIs in Region 7, and 2 HEIs in Regions 2 and 3. Table 1 details the HEIs in each region that have COEs in Engineering and Technology by Region as of 2018.

An analysis of the number of HEIs offering Engineering and IT-Related programs, and the number of faculty in these respective fields holding a PhD degree revealed that Computer Engineering is offered by the greatest number of HEIs with 342 institutions, followed by Civil engineering with 250, and Electronics Engineering with 209. On the other hand, Civil Engineering has the greatest number of faculty with doctorate degrees having 400 instructors, followed by 354 PhD faculty in Computer Science, and 308 in Chemical Engineering.

In addition, when comparing the number of HEIs with Engineering Programs having COEs and their number of faculty members having PhD degrees, by program in 2018. It was determined that Information technology has COEs in 14 HEIs, having the greatest number of universities, this is followed by Chemical Engineering and Electronics Engineering which are offered by 5 universities, and by Electrical Engineering and Mechanical Engineering which are both offered by 4 universities. In contrast, however, Chemical Engineering has the most PhD faculty at 21, followed by Electrical Engineering with 18, and Agricultural Engineering with 15. It is notable that although Information Technology has the greatest number of universities with COEs, it does not have any PhD faculty. Additionally, there are only 43 engineering and IT-related programs with COEs, which only make up about 2% of total HEIs.

The same report also summarized the number of faculty based on their highest degree obtained in each institution type. The general trend across the four institution types is that majority of the faculty has the Baccalaureate degree as their highest degree, followed by Master's and PhD respectively. However, for Other Government Schools (OGS), a higher number of faculty has obtained a Master's degree compared to a Bachelor's degree. Nonetheless, PhD faculty remain to be a minority.

These figures are further broken down into the number of faculty by their degree in each STEAM field during AY 2018-2019. In Science, Technology, and Engineering, majority of the faculty remain to have attained Bachelor's as their highest degree, followed by Master's and Doctorate. However, in Agriculture and Mathematics, more faculty have Master's degrees, followed by PhD and Bachelor's degree respectively, while in Mathematics, most faculty have Master's degree, followed by Bachelor's and

PhD degrees. In even more detail, the report summarized the faculty profile based on highest degree attainment in each Engineering and IT-Related Program. The general trend which may be observed is most faculty have Bachelor's degree followed by Master's and Doctorate degrees. However, most of the faculty in Agricultural Engineering, Chemical Engineering, Industrial Engineering, Management Engineering, and Metallurgical Engineering have attained Master's Degree compared to Bachelor's degrees.

Two Philippine-based universities listed in the world's top research-intensive universities by the Times Higher Education (THE) World University Rankings 2019. These include University of the Philippines in the rank 401-500, and De La Salle University in the 1000+ bracket. Specifically for the Engineering and Technology field, De La Salle University placed in the 501-600 bracket, while University of the Philippines is in the 601-800 bracket.

Given this, the number of faculty with PhD degrees in University of the Philippines-Diliman and De La Salle University in each program is determined. Electrical Engineering has the greatest number of PhD faculty with 25 faculty, followed by Chemical Engineering with 24 faculty. Lastly, Civil Engineering and Electronics Engineering tied with 12 PhD faculties each.

The study aims to evaluate the existing research management approaches of Higher Education Institutions (HEIs) in the Philippines. This assessment will give a picture of the research capacity and readiness of Philippine HEIs in achieving the national research agenda and allow the identification of primary determinants of an institution's research capacity. From this, areas which need improvement may be determined, and strategies to address them may be recommended for prioritization. The results of this study may be utilized by HEIs and relevant government agencies in directing resources to prioritized initiatives that would ensure the improvement of their capacity to generate relevant and quality research.

Specifically, the objectives of this study include:

1. to assess the readiness of Higher Education Institutions (HEIs) in the Philippines to undertake quality research
2. to analyze the important indicators of institutional research success
3. to determine the areas for intervention to increase research capacity of HEIs
4. to identify the priority HEIs for support in strengthening of research capacity
5. to develop a ranking approach to prioritize HEIs research readiness.

RESEARCH METHODOLOGY

The study, which is national in scope, implemented a survey-correlational research approach. A self-administered questionnaire was sent to more than 1000 Higher Education Institutions (HEIs) from all over the Philippines. The questionnaires were electronically sent based on the HEIs' institutional emails which were obtained from their official websites or other social media platforms. A software was used to check whether the email was clicked or opened upon sending. Primary data were collated through the accomplished questionnaires while respondents who clicked or opened the email but did not respond to the survey were either: (1) regarded to have no authority to answer the survey questionnaire, or (2) imply that their institution is not ready to answer the survey, indicating a low level of research readiness.

The survey questions were divided into four clusters. Each cluster pertains to the indicator of institutional research capacity. The four clusters were: (1) Institutional Commitment, (2) Human Resources, (3) Laboratories and Infrastructure, and (4) Organizational Support. The institutional commitment cluster was centered on the local and international linkages of the institution, existing research collaborations, autonomous status from the Commission on Higher Education (CHED), and whether the institutions have recognized center of excellence or center of development status. The human resources cluster was focused on the research capabilities of the human resources of the institution such as the researchers' highest educational attainment, capacity to publish in scientific journals, and awards and recognitions obtained. Research grants from external sources are also considered in this cluster. The laboratories and infrastructure cluster were dedicated to the research facilities, innovation centers, and digital infrastructure of the institution. Finally, the organization structure cluster was also considered. This cluster concentrated on the existing research plans and programs of the institution. Provision for financial rewards and recognitions for every successful publication of the faculty was also examined in this cluster. These four clusters have different weight contributions to the overall research capacity indicator. The following are the distribution of each indicator to the overall research readiness of the institution: Institutional Commitment – 40%, Human Resources – 30%, Laboratories – 10%, and Organizational Support – 20%.

The second part of the survey focused on the research-related specifics of each HEIs. For instance, the areas of research being undertaken by the HEIs were studied including the number of Ph.D. holders in the HEIs' faculty roster specializing in the different research domains. Analyses were done on the capacities of the HEIs to research the following priority research areas: (1) Clean and Renewable Energy, (2) Resilient Infrastructure, (2) Smart Agriculture, (3) Sustainable Transportation, (4)

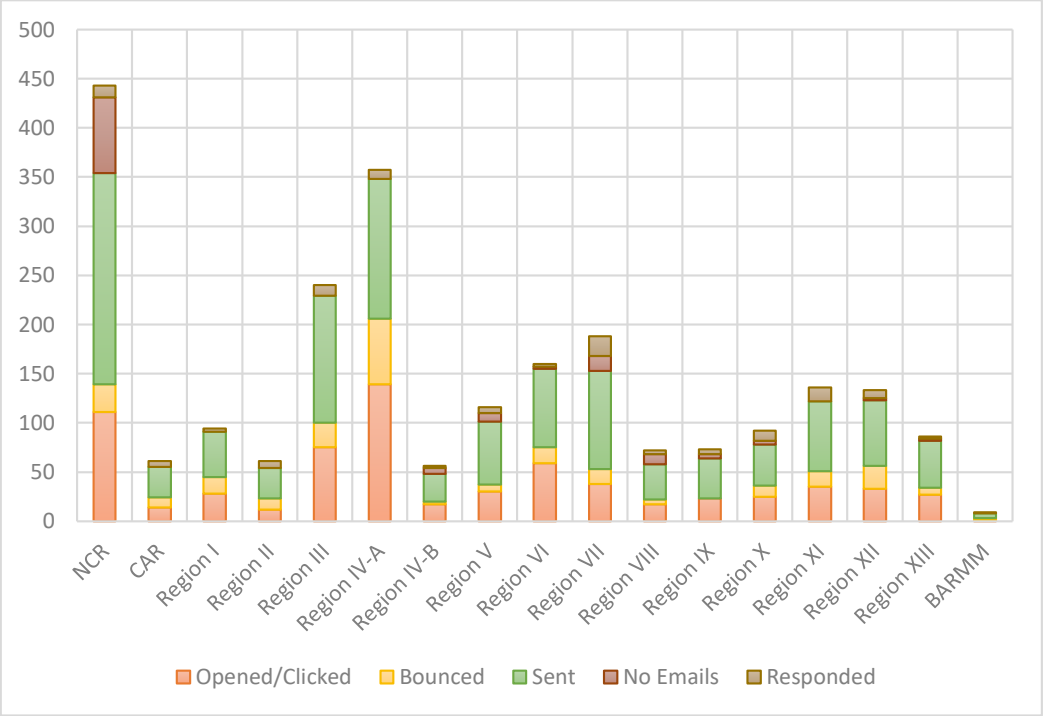
Industry 4.0, (5) Health and Wellness, etc. The capacities of the HEIs in the basic research areas such as Water Security, Food and Nutrition, Natural Products, etc. were also assessed. The same assessments were also done in the health, agriculture, emerging technology, and disaster preparedness and mitigation sectors. In addition to the research areas, the programs being offered at the Ph.D. level by the HEIs were also examined. The Research and Development (R&D) needs or interventions required based on the HEIs' perspective were also evaluated.

Descriptive statistics such as percentages, frequency, average, standard deviation, and range were utilized to represent and illustrate the data. Linear regression analyses were used to determine a possible relationship or correlation between the indicators of institutional research capacity and the research readiness of HEIs. Single-factor analysis of variance was also used to assess for mean differences between the input groups to drive more conclusions using the survey results.

RESULTS AND DISCUSSION

The summary of the survey dissemination statistics is shown in Figure 1. The self-administered survey questionnaire was successfully sent to a total of 1176 Higher Education Institutions (HEIs). Only about 10% or 123 HEIs responded while the remaining 90% either clicked, opened, or entirely disregarded the email and no response was reverted. On average, this statistic indicating low reception is about 40 HEIs per region. The low response rate may reflect the HEIs' lack of preparedness in answering survey questions, which may likewise suggest a low level of research capacity.

Figure 1
Survey dissemination statistics per region.



The distribution of respondents per region is not uniform as shown in Table 1. The region with the highest number of respondents is Region VII with 20 respondents followed by Region XI with 14 respondents and NCR with 12 respondents. On average there are only about 7 responses obtained from the HEIs per region. A total of 263 emails were bounced, with 131 HEIs having no email addresses in any digital platform.

Table 1*Tabular survey dissemination statistics per region.*

Region	Opened/Clicked	Bounced	Sent	No Emails	Responded
NCR	111	28	215	77	12
CAR	14	10	31	0	6
Region I	28	17	46	0	3
Region II	12	11	31	0	7
Region III	75	25	129	0	11
Region IV-A	139	67	142	0	9
Region IV-B	17	3	28	6	2
Region V	30	7	64	9	6
Region VI	59	16	80	2	3
Region VII	38	15	100	15	20
Region VIII	17	5	36	10	4
Region IX	23	0	41	4	5
Region X	25	11	42	4	10
Region XI	35	16	71	0	14
Region XII	33	23	67	2	8
Region XIII	27	7	48	2	2
BARMM	1	2	5	0	1
TOTAL	684	263	1176	131	123

Linear regression analyses were done to verify if there are possible correlations between the data. Results show that there is a very strong correlation between the number of opened or clicked emails vs the total HEIs considered with an R2 value of 0.80 (Table 2). There is also a high correlation between the number of sent emails vs the total HEIs considered with an R2 value of 0.98 (Table 3). These results suggest that the number of opened, clicked, or sent emails can be estimated with relatively high accuracy by just considering the projected number of HEIs considered. Finally, results from single-factor analysis of variance (ANOVA) suggest that there is a statistically significant difference between the means of all the input values considered in Table 1.

Table 2

Correlation of opened/clicked emails vs the total number of HEIs considered in the study.

SUMMARY OUTPUT

<i>Regression Statistics</i>						
	0.90292					
Multiple R	8					
	0.81527					
R Square	8					
Adjusted R	0.80296					
Square	3					
	16.2607					
Standard Error	4					
Observations	17					

ANOVA						
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	1	17504.89	17504.89	66.20317	6.99E-07	
Residual	15	3966.174	264.4116			
Total	16	21471.06				

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.31717		0.0503	0.9604		13.7339
	1	6.294665	87	79	-13.0996	3
	0.43223		8.1365	6.99E-07		0.54546
Total	4	0.053123	33	07	0.319006	3

Table 3
Correlation of sent emails vs the total number of HEIs considered in the study.

SUMMARY OUTPUT						
<i>Regression Statistics</i>						
	0.99183					
Multiple R	9					
	0.98374					
R Square	5					
Adjusted R	0.98266					
Square	1					
	6.87341					
Standard Error	8					
Observations	17					
<i>ANOVA</i>						
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	1	42887.81	42887.81	907.79	7.8E-15	
Residual	15	708.6582	47.243	61		
Total	16	43596.47	88			
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	6.69411	2.660757	2.5158	0.0237	1.022842	12.3653
	0.67656		67	5		8
Total	1	0.022455	30.129			0.72442
			66	7.8E-15	0.628699	2

Research Readiness Profile of HEI Respondents

The profile of the HEI respondents was assessed based on the research readiness indicators (i.e., Institutional Commitment, Human Resources, Laboratories, and Organization Support). The survey responses related to these indicators were collated and summarized. In terms of institution capacity, only 24% of the HEI respondents affirmed that their institutions have been granted Commission on Higher Education (CHED) autonomous status while only 19% declared that their academic programs have been recognized as Center for Excellence (COE) or Center of Development (COD). Meanwhile, about 26% of the respondents indicated that their institutions offer Ph.D. programs under the Science, Technology, Engineering, Agriculture, and Mathematics (STEAM) field. However, about 67% revealed that their institutions do not offer any Ph.D. programs. In terms of STEAM faculty with Ph.D., a huge percentage (92%) of the HEI respondents indicated that their institutions only

have less than 25% Ph.D. degree holders in their STEAM faculty roster. Half of this group even indicated that they do not have Ph.D. holders in their STEAM faculty at all. Only about 4% of the HEI respondents indicated that more than half of their STEAM faculty roster have Ph.D. degrees. In terms of collaboration, 69% of the HEI respondents affirmed existing local and/or international linkages with their institution. Meanwhile, 56% of the HEI respondents indicated that there is an existing research collaboration with other institutions, industries, and/or local government units (LGUs). For R&D management capacity, 90% of the HEI respondents stated that their institutions have existing research plans and programs while 56% affirmed that their faculty receive financial rewards and recognitions for research publications. About 81% also declared that their institutions have manuals or guidelines for research. For laboratory capacity, 60% of the HEI respondents indicated that there are existing research facilities and laboratories in their institutions while only 39% pointed out that they have existing research or innovation centers and/or institutes. Finally, 79% of the HEI respondents declared that their institutions have strong internet connectivity.

Research Capacity Performance of HEIs

Primary data obtained from the 123 respondents were used to analyze the research capacity of the Higher Education Institutions (HEIs) in the Philippines. The average research capacity score per region is also illustrated in Figure 2. It can be observed that the highest average research capacity score is 2.84 obtained by Region 4A followed by a score of 2.74 obtained by CAR then a score of 2.42 obtained by NCR and Region 6. It must be highlighted that the national average research capacity score is 2.12. Based on this benchmark, about 53% of all the regions in the Philippines obtained a score below the national average. This result highlighted the current low level of research readiness of the HEIs, especially at the national level.

Figure 2
Average research capacity score of HEIs per region.

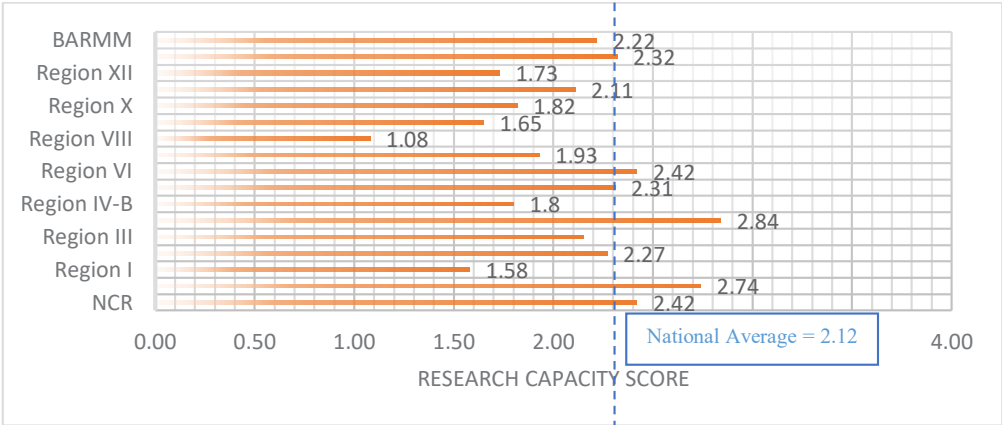


Figure 3 summarizes the HEIs which obtained the highest research capacity scores. A total of 12 HEIs obtained a perfect research capacity score of 4.0 which corresponds to about 10% of the respondents. Interestingly, only 1 HEI from the 12 NCR respondents obtained a perfect research capacity score of 4.0 while the region with the most HEIs obtaining a perfect research capacity score is CAR with 3 or about 50% of all the CAR respondents. Meanwhile, clustering the HEIs per distinct island groups revealed that Luzon HEIs obtained the highest average research capacity score of 2.26, followed by Mindanao with 1.97 then the Visayas with 1.81. The overall median of the research capacity score is 2.03 while the lowest obtained research capacity score is 0.13. The summary of the descriptive statistics for the overall research capacity scores obtained by the HEIs is shown in Table 4.

Figure 3
HEIs obtaining the highest research capacity scores.

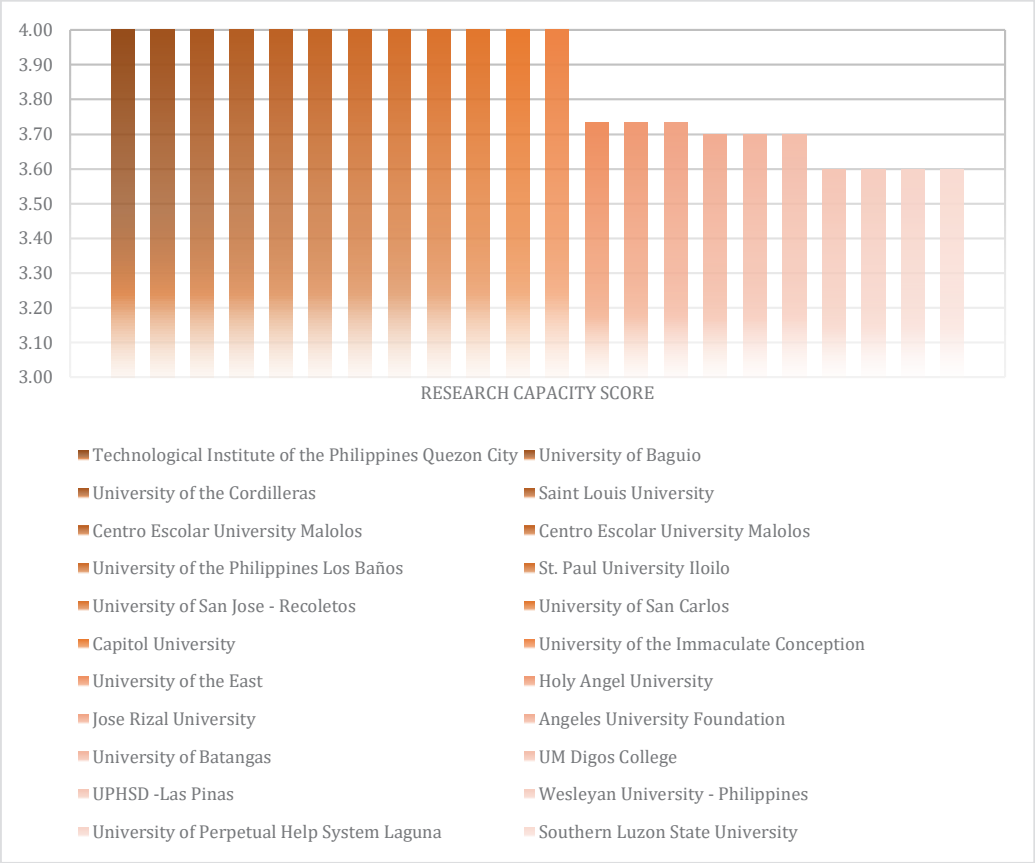


Table 4
Descriptive statistical results of research capacity scores for all HEI respondents.

Descriptive Statistics Results	
Mean	2.116
Standard Error	0.100
Median	2.033
Mode	4.000
Standard Deviation	1.114
Sample Variance	1.241
Kurtosis	-1.019
Skewness	0.207
Range	3.867
Minimum	0.133
Maximum	4.000
Sum	260.233
Count	123.000
Confidence Level (95.0%)	0.199

Research Capacity Score and Its Driver

Each indicator of the research capacity scores was examined to determine which component drives the research capacity of the Higher Education Institutions (HEIs). Table 5 summarizes the descriptive statistics for each raw research capacity indicator score obtained by the HEIs. Based on this table, the indicator with the highest obtained raw mean is Organization Support with 3.024 followed by Laboratories and Infrastructure with 2.396, Human Resources with 2.138, and Institutional Commitment with 1.732. The result suggests that the indicator with the most affirmative response is the Organization Support while the indicator with the least affirmative response is Institutional Commitment. Consequently, it can also be interpreted that the level of support of each HEIs for the research capacity indicators follows the same order. Meanwhile, when the weighted research capacity indicator score is considered, the indicator with the highest weighted mean is Institutional Commitment with 0.693, followed by Human Resources with 0.641, Organization Support with 0.605, and Laboratories and Infrastructure with 0.240. This observation was expected since the same order follows the weighted contribution established in the methodology (i.e., 40% for the Institutional Commitment, 30% for the Human Resources, 20% for the Organization Support, and 10% for the Laboratories and Infrastructure).

Table 5
Descriptive statistical results of each research capacity indicator for all HEI respondents.

<i>Descriptive Statistics Results</i>				
<i>Category</i>	<i>C</i>	<i>HR</i>	<i>L</i>	<i>O</i>
Raw Mean	1.732	2.138	2.396	3.024
Standard Error	0.117	0.118	0.123	0.113
Median	2.000	2.000	2.667	4.000
Mode	2.000	1.000	4.000	4.000
Standard Deviation	1.300	1.308	1.365	1.255
Sample Variance	1.690	1.710	1.864	1.576
Kurtosis	-0.767	-1.380	-1.103	0.170
Skewness	0.354	0.209	-0.279	-1.102
Range	4.000	4.000	4.000	4.000
Minimum	0.000	0.000	0.000	0.000
Maximum	4.000	4.000	4.000	4.000
Sum	213.000	263.000	294.667	372.000
Count	123.000	123.000	123.000	123.000
Confidence Level (95.0%)	0.232	0.233	0.244	0.224

Based on the descriptive statistical result, the indicator with the highest standard deviation was obtained in the Laboratories and Infrastructure with 1.365 followed by Human Resources (1.308), Institutional Commitment (1.300), and Organizational Support (1.255). This signifies that there is more disparity in the responses of the

HEIs in the Laboratories and Infrastructure indicator than the other research capacity indicators. Moreover, this observation could indicate that there is more disparity in the existence of research facilities/laboratories among the HEIs as well as the existence of research/innovation centers.

To determine the main driver of the research readiness of the HEIs, statistical linear regression was conducted. The HEIs were clustered per region and the raw regional research capacity score was utilized. This regional score is based on the average unweighted research capacity score of all the HEIs under the same region. Examination of the effects of research readiness indicators (i.e., Institutional Commitment, Human Resources, Organizational Support, and Laboratories and Infrastructure) on driving the regional research capacity revealed that of the four indicators considered, only the Institutional Commitment was found to significantly drive the research capacity score ($\beta = 0.08$, $p = 0.035$, Table 6). This implies that the high level of institutional commitment is the key driver of HEI's research capacity improvement, especially on the regional level. This institutional commitment is characterized by the presence of local and/or international linkages of the HEIs, the existence of research collaborations with other stakeholders, the CHED autonomous status grants, and the existence of center of excellence/center of development of the programs offered in the HEIs. This validates the initial assumption that the indicator with the most weight in terms of research capacity score is indeed Institutional Commitment at 40%.

Table 6

Research readiness indicators affecting regional research capacity scores (dependent variable: research capacity score)

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.37568
	0.14113
R Square	5
Adjusted R	0.11202
Square	1
	0.34537
Standard Error	2
Observations	123

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	4	2.312959	0.5782	4.84766	0.001178
			4	4	
Residual	118	14.07529	0.1192		
Total	122	16.38825	82		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	2.05851		24.307	9.15E-		2.22621
	2	0.084685	77	48	1.890812	2
	0.08000		2.1313	0.0351		0.15433
Commitment	5	0.037536	87	32	0.005672	7
			-			
Human Resources	-0.0179	0.038448	0.4656	0.64234		0.05823
			3	1	-0.09404	6
				0.90057		0.05189
Laboratories	-0.0035	0.027973	-0.1252	6	-0.0589	2
	0.05758		1.6907	0.09351		0.12503
Organization	7	0.034059	93	6	-0.00986	4

Note: Bold = the significant predictor variable (Sig. < 0.05).

Dominant Research Areas and R&D Assistance Required by HEIs

Another part of the survey aimed at classifying the other pertinent information related to the research capability of the HEIs like the research area focus of the institution, human resources demographics, and the required assistance to improve research undertakings. The common priority research areas conducted among the HEI respondents are as follows: Health and Wellness (27%), Clean and Renewable Energy (8%), Industry 4.0 (8%), Smart Agriculture (7%), Resilient Infrastructure

(6%). Although, 39% of the HEI respondents indicated that their research areas do not fall on the said priority research categories. Meanwhile, 34% of the HEI respondents revealed that none of their Ph.D. faculties engage in the said research areas while 42% indicated that at least 2-3 Ph.D. faculties have done related research. Only about 10% of the HEI respondents implied that 4-8 of their Ph.D. faculties have done related research.

In terms of the basic research areas conducted by the HEIs, Sustainable Communities (24%) are the dominant area followed by Food and Nutrition (12%), Natural Products (10%), Water Security (5%), and Clean Energy (8%). However, 16% indicated other research areas while 24% declared that they do not conduct research on such topics. Meanwhile, 40% of the HEI respondents revealed that none of their Ph.D. faculties engage in the said research areas while 35% indicated that at least 2-3 Ph.D. faculties have done related research. Only about 10% of the HEI respondents implied that 4-8 of their Ph.D. faculties have done related research.

For research topics related to health as conducted by the HEIs, Nutrition, and Food Safety (16%) is the dominant area followed by Drug Discovery (12%), Functional Food (7%), Diagnostics (6%), and Biomedical Devices (5%). However, 8% indicated other research areas while 44% declared that they do not conduct research on such topics. Meanwhile, 46% of the HEI respondents revealed that none of their Ph.D. faculties engage in the said research areas while 24% indicated that at least 2-3 Ph.D. faculties have done related research. Only about 4% of the HEI respondents implied that 4-8 of their Ph.D. faculties have done related research.

The common agriculture research areas conducted among the HEI respondents are as follows: Socio-Economic Impacts (25%), Natural Resources and Environment (14%), Agriculture (Crops) (9%), Agriculture (Livestock) (6%), Aquaculture (4%), Fisheries (3%), and Forestry (2%). Although, 36% of the HEI respondents indicated that their research areas do not fall on the said priority research categories. Meanwhile, 46% of the HEI respondents revealed that none of their Ph.D. faculties engage in the said research areas while 21% indicated that at least 2-3 Ph.D. faculties have done related research. Only about 5% of the HEI respondents implied that 4-8 of their Ph.D. faculties have done related research.

For research topics related to emerging technologies as conducted by the HEIs, Artificial Intelligence, Internet of Things, and Data Analytics (14%) is the dominant area followed by Food and Nutrition (12%), Renewable and Alternative Energy (9%), Human Security (7%), Energy Storage Systems (5%) and Competitive Manufacturing (5%). However, 2% indicated other research areas while 44% declared that they do not conduct research on such topics. Meanwhile, 45% of the HEI respondents revealed that none of their Ph.D. faculties engage in the said research areas while 18%

indicated that at least 2-3 Ph.D. faculties have done related research. Only about 5% of the HEI respondents implied that 4-8 of their Ph.D. faculties have done related research.

Finally, for the research topics related to disaster preparedness and mitigation, the following are the dominant research areas: Risk Management, Assessment, and Communication (17%), Climate Change Mitigation and Adaptation (15%), Policy Studies (14%), Observation and Monitoring Network and Application (7%), Modeling and Simulation for Forecasting and Monitoring (7%), and Hazard Vulnerability Assessment (6%). However, 34% indicated that they do not conduct research on such topics. Meanwhile, 40% of the HEI respondents revealed that none of their Ph.D. faculties engage in the said research areas while 27% indicated that at least 2-3 Ph.D. faculties have done related research. Only about 3% of the HEI respondents implied that 4-8 of their Ph.D. faculties have done related research.

Overall, the most dominant research topic among the HEI respondents is the Health and Wellness topic area with 48 studies, followed by Sustainable Communities with 39 studies, Socio-Economic Impacts with 39, Risk Management, Assessment, and Communication with 30, Climate Change Mitigation and Adaptation with 26, and Policy Studies with 24. On average, about 35% of the HEI respondents admitted that their institutions do not conduct any research related to the research cluster in question while about 42% of the HEI respondents indicated that no Ph.D. holder is doing a related study to the research cluster in question.

The HEI respondents were also asked about the possible R&D assistance that they perceive to be vital in improving the research readiness of their institutions. Among the frequently identified assistance needed are as follows: (1) Search for Funding Opportunities and Experts (79 HEIs), (2) Writing of Comprehensive Research Proposals for External Funding (79 HEIs), (3) Writing of Paper for Journal Publication (73), (4) Establishing International or Local Research Collaboration and Networking (71), and Guidance on Project/Research Program Implementation (57).

CONCLUSIONS AND RECOMMENDATIONS

Building research capacity in HEIs requires an assessment of research management methods and the identification of transitory mechanisms to facilitate the evolution of the research agenda. A total of 123 Higher Education Institutions (HEIs) situated in different parts of the country responded to the self-administered survey to assess their state of research readiness. The national research readiness based on the weighted indicators yielded an average score of 2.12. About 53% of all the regions in the Philippines obtained a score below the national average. This highlights the existing poor degree of research readiness of HEIs, particularly at the national level.

Based on descriptive statistics, the Organization Support indicator has the highest raw mean (3.024) for research capacity score, followed by Laboratories and Infrastructure (2.396), Human Resources (2.138), and Institutional Commitment (1.732). This sequence also suggests the order of the indicators in terms of affirmative response. Additionally, the Laboratories and Infrastructure indicator had the largest standard deviation (1.365), followed by Human Resources (1.308), Institutional Commitment (1.300), and Organizational Support (1.300). (1.255). This shows that the Laboratories and Infrastructure indicator has a higher disparity than the other research capacity metrics. This finding may also indicate a greater gap in research facilities/laboratories and research/innovation centers among HEIs.

Furthermore, the result of linear regression suggests that the main driver of the research capacity of an institution is the institutional commitment characterized by the existence of local and/or international linkages of the HEIs, existence of research collaborations with other stakeholders, the granting of CHED autonomous status, and the existence of center of excellence/center of development of the programs offered in the HEIs.

The study also confirms that research in the topics of Health and Wellness, Sustainable Communities, and the Agricultural Socio-Economic Impacts are the most dominant areas of research conducted by the HEIs. However, there is a need to strengthen the focus of research on other important topic clusters Clean and Renewable Energy, Industry 4.0, and Water Security. It is also required to develop human resource expertise, as a substantial number (72% on average) of HEIs revealed that just 2-3 Ph.D. holders do research on the survey's pre-determined priority research areas. This implies that research outputs and quality are significantly low.

There is a need for sufficient support to build research capacity. Close supervision and mentoring of faculty researchers are also important. As highlighted by the HEI respondents, some of the typical support needed is the search for financing sources, technical aid in developing research proposals for funding and journal publishing, and the establishment of collaborations between institutions.

This study presents a comprehensive assessment on the research readiness of HEIs in the Philippines and reveals pressing areas where resources and support need to be directed to strengthen research capacity. These improvements include focusing on building organization support and commitment, laboratory and infrastructure accessibility, linkages for collaborations, and human resource capacity. Lastly, this study also reveals dominant research areas and other priority research areas where expertise needs to be developed. The results of this study may serve as a guide for national and organizational support in building research capacity in the Philippines.

As a recommendation for future work, a detailed faculty profile, research budget, and publication details would be beneficial to further correlate the research capacity indicators to a more direct gauge of the HEIs' research capacity. A further in-depth study might be performed by cross-referencing the derived research capability scores with more specific indicators of research readiness.

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REFERENCES

- Commission on Higher Education. (2009). National Higher Education Research Agenda (2009-2018). <https://ched.gov.ph/wp-content/uploads/2017/11/NHERA-2.pdf>
- Heitor, M., Horta, H., & Mendonça, J. (2014). Developing human capital and research capacity: Science policies promoting brain gain. *Technological Forecasting and Social Change*, 82, 6-22. <https://doi.org/10.1016/j.techfore.2013.07.008>
- ESSENCE on Health Research. (2014). Seven principles for strengthening research capacity in low- and middle-income countries: simple ideas in a complex world. ESSENCE: Good Practice Document Series, 1-36.
- Heitor, M., Horta, H., & Mendonça, J. (2014). Developing human capital and research capacity: Science policies promoting brain gain. *Technological Forecasting and Social Change*, 82, 6-22. <https://doi.org/10.1016/j.techfore.2013.07.008>
- Huenneke, L. F., Stearns, D. M., Martinez, J. D., & Laurila, K. (2017). Key Strategies for Building Research Capacity of University Faculty Members. *Innovative Higher Education*, 42(5-6), 421-435. <https://doi.org/10.1007/s10755-017-9394-y>
- Ochave, R. D. (2022, June 14). *PHL competitiveness ranking improves*. BusinessWorld Online. <https://www.bworldonline.com/top-stories/2022/06/15/455047/phl-competitiveness-ranking-improves/>
- Okereafor, G., Muiyiwa Ogungbangbe, B., & Anyanwu, A. (2015). Positioning Nigeria For Global Competitiveness In The 21st Century: The Policy Imperatives. *The International Journal of Management Science and Business Administration*. <https://doi.org/10.18775/ijmsba.1849-5664-5419.2014.110.1005>
- OPRKM-Knowledge Management Division of the Commission of Higher Education. (2019). Statistics. CHED. <https://ched.gov.ph/statistics/>
- Polyakov, M., & Kovshun, N. (2021). Diffusion of Innovations as a Key Driver of the Digital Economy Development. *Baltic Journal of Economic Studies*. <https://doi.org/10.30525/2256-0742/2021-7-1-84-92>
- Sawyerr, A. (2004). African Universities and the Challenge of Research Capacity Development. *Journal of Higher Education in Africa*, 2(1), 213-242.
- Segrott, J., McIvor, M., & Green, B. (2006). Challenges and strategies in developing nursing research capacity: A review of the literature. *International Journal of Nursing Studies*, 43(5), 637-651. <https://doi.org/10.1016/j.ijnurstu.2005.07.011>

Shkarlet, S., Kholiavko, N., Dubyna, M., & Zhuk, O. (2019). Innovation, Education, Research Components of the Evaluation of Information Economy Development (as Exemplified by Eastern Partnership Countries). *Marketing and Management of Innovations*. <https://doi.org/10.21272/mmi.2019.1-06>

UNESCO. (1998). World Declaration on Higher Education for the Twenty-First Century: Vision and Action. In *World Conference on Higher Education*.

Zakharkina, L., Myroshnychenko, I., Smolennikov, D., & Pokhylko, S. (2018). Efficiency of innovation activity funding as the driver of the state's national economic security. *Montenegrin Journal of Economics*. <https://doi.org/10.14254/1800-5845/2018.14-4.11>