

Performance Efficiency in Research of the Departments of College of Arts and Sciences: Basis for a Research Capability Training Program

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Abstract—The aim of this study is to determine the performance efficiency in research of the four departments of the College of Arts and Sciences in DMMMSU-SLUC using Data Envelopment Analysis (DEA) Solver during the years 2015 and 2016. It also determined the: (1) performance efficiency level of the departments in research; (2) peer groups and weights of the departments; (3) virtual inputs and virtual outputs or potential improvements of the departments; (4) research capability building training program that can be developed based on the results. Findings of the study showed that: 50% of the departments are fully efficient while the other 50% are inefficient in research. The fully efficient departments, BPSD and MADD, serve as models for improvement in research of the inefficient departments, LD and HSSD, to be in the efficient frontier. The BPSD and MADD serve as peers for the inefficient HSSD and LD, respectively, with different weights to consider. Fully efficient departments do not have virtual inputs and virtual outputs. Only HSSD and LD posted virtual inputs and virtual outputs in the research input and output indicator. Based on the results, a CAS Capability Building Training Series was developed to sustain the performance in research of the College of Arts and Sciences and to achieve a better research performance for all the college's departments.

Index Terms— College of Arts and Sciences, Data Envelopment Analysis, DMMMSU, Peers and weights, Performance efficiency, Research, Research Capability Training Program, Virtual input, Virtual output

1 INTRODUCTION

The onset of globalization demanded the critical attention to research in order to generate knowledge and discover new strategies [1]. Higher Education Institutions (HEIs) do not only produce graduates. More importantly, they create knowledge [2]. Towards this end, the Philippine Commission on Higher Education (CHED) in 1994 was mandated to ensure and protect the advancement of learning in higher education institutions through productive and useful researches, pursuant to Republic Act No. 7722. Thus, universities include in their functions the conduct of research which primarily pushes the generation of knowledge and relevant technologies.

Philippine colleges and universities, as centers of knowledge production and generation, play a critical role in the country's national research and development projects. Thus, research capacities increasingly receive recognition as one important indicator in assessing the performance efficiency of HEIs in the country. Consequently, promoting research performance and striving for research excellence has become a prominent goal to be attained by the HEIs in the country.

The Don Mariano Marcos Memorial State University (DMMMSU), one with Level IV accredited programs and among the top 22 state universities and colleges (SUCs) in the Philippines, supports researches that lead to the innovation, integration, and circulation of new knowledge which are contributory to the attainment of its philosophy, vision, mission, and goal. At the same time, the university recognizes that research is fundamentally bound to the quality of its

teaching, programs, and outreach or community extension projects. To advocate this worthwhile endeavor and to preserve integrity in the research and scholarly activities of its manpower, DMMMSU has established a number of policies that deliver an institute for research practice at the university. The level to which the various colleges and institutes of the university adheres to the policies on research determine their efficiency.

Every college or institute in the university must maintain an excellent research culture and environment in order to advance knowledge, and apply this new knowledge to improve the quality of human life and respond effectively to the challenges of globalization, hence, contributing to the overall performance of DMMMSU. This study is based on the belief that every department contributes significantly to the overall performance of the college or institute. It aimed to determine the efficiency in research of the four departments, namely Biological and Physical Sciences Department (BPSD), Humanities and Social Sciences Department (HSSD), Languages Department (LD), and Mathematics and Allied Disciplines Department (MADD) of the College of Arts and Sciences in 2015 and 2016 using Data Envelopment Analysis. The results of this study served as input in the development of a Research Capability Training Program for the College in order to enhance or sustain its performance in terms of research.

1.1 Objectives of the Study

This study focused mainly on the determination of the performance efficiency in research of the four departments

(BPSD, HSSD, LD, MADD) of the College of Arts and Sciences (CAS) in 2015 and 2016 using Data Envelopment Analysis (DEA).

Specifically, this study determined: a) the performance efficiency level in research of the departments of CAS using DEA; b) the peer groups (reference or model for improvement) and weights (percentage to be adapted) in research of the departments of CAS; c) the virtual inputs or virtual outputs (potential improvements) in research of the departments of CAS to be in the efficient frontier; and d) the Research Capability Training Program for the CAS that can be proposed based on the findings of the study.

2 METHODOLOGY

2.1 Research Design

This study employed the descriptive evaluative design. Primarily, the study is a data-based analysis study. Data were gathered from existing documents in research of the four departments (BPSD, HSSD, LD, MADD) of CAS. The main objective of this study is to determine the performance efficiency in research of the four departments using Data Envelopment Analysis in 2015 and 2016. The results of the analyses served as bases for the researchers in developing a Research Capability Training Program for the college.

2.2 Sources of Data

The four departments of the College of Arts and Sciences of Don Mariano Marcos Memorial State University – South La Union Campus, La Union, Philippines served as the decision-making units (DMUs) or respondents of this study. These are the following: the Biological and Physical Sciences Department (BPSD), the Humanities and Social Sciences Department (HSSD), the Languages Department (LD), and the Mathematics and Allied Disciplines (MADD).

2.3 Instrumentation

Necessary data for the study were collected from existing research-related documents of the BPSD, HSSD, LD, and MADD. A structured instrument, which purely identified research-related quantitative data of the four departments of CAS, was distributed to and was accomplished by the research facilitator of each department.

2.4 Analysis of Data

This study used frequency counts and the Multi-Stage Input-Oriented Constant Returns-to-Scale Model through DEA add-ins in MS Excel in the management and analysis of data. The Multi-Stage Input-Oriented Constant Returns-to-Scale Mode was used to determine the desired weight and efficiency of a DMU to enhance its efficiency by minimizing its inputs while producing the projected amount of outputs [3].

3 RESULTS AND DISCUSSIONS

Performance Efficiency in Research

The means and total frequencies of the data gathered for the input and output indicators in research from the four departments of the College of Arts and Sciences in 2015 and 2016 were determined and were plugged-in into the DEA Solver which is an add-in in the Microsoft Excel. The data were analyzed by the DEA Solver to determine the performance efficiency score in research of the departments.

Table 1 presents the input and output scores, and efficiency level in research of the BPSD, HSSD, LD, and MADD.

TABLE 1
EFFICIENCY LEVEL IN RESEARCH
OF THE FOUR DEPARTMENTS OF CAS

Indicators	Decision-Making Units			
	BPSD	HSSD	LD	MADD
Input				
1. Number of faculty	19	20	17	15
2. Number of on-going researches	7	7	13	11
Output				
1. Number of faculty involved in research	12	9	12	15
2. Number of completed researches	3	2	1	7
3. Number of research presentations	11	2	10	33
4. Number of research articles published	54	12	27	51
Efficiency Score	1.00***	0.75*	0.71*	1.00***
***Fully efficient **Weak Efficient *Inefficient				

The table shows that the departments have varying input and output data. As to input indicators, HSSD and MADD have the greatest and least number of faculty members, respectively. On the other hand, LD posted the highest number of on-going researches with an average of 13 distinct researches annually.

In terms of accomplishments, 100% of the MADD faculty members are involved in research undertakings while only 45% or nine faculty members from the HSSD are involved. Of the 11 average on-going researches from the MADD, a total of seven or 64% was completed in 2015 and 2016. Though LD has the highest number of on-going researches, it recorded the lowest number of research with only one completed research study. Further, presentation of research outputs and publication to refereed journals are noted as strengths of the BPSD with 54 and MADD with 51, respectively.

The performance of the four departments in research can be generalized in terms of their efficiency scores. It can be noted from the table that research is a strength of the BPSD and MADD as reflected in their efficiency scores of 1.00, described as fully efficient. On the other hand, HSSD and LD were found to be inefficient in

research in 2015 and 2016 as their input and output scores deliver efficiency scores of 0.75 and 0.71, respectively.

Results of the analyses reflect that the fully efficient departments, BPSD and MADD, are committed in achieving excellent research performance by providing the faculty members with an effective research capacity building management system. Their dedication and active involvement in research endeavours are reflected in the number of on-going and completed researches, and number of faculty members who are involved in research undertakings. These were supported by the publication of their outputs in different local and international journals, and presentation to various local and international conferences, contributed significantly to the departments' fully efficient performances in research.

The BPSD and MADD, though operating with full efficiency, are encouraged to continuously promote a research-based environment in their respective departments to sustain their performance efficiency.

On the other hand, the weak efficient performances of HSSD and LD may have been a result of the very high frequencies in the input indicators but low output scores or accomplishments. To become fully efficient, the two departments are recommended to perform necessary improvements in their research operations. They may consider a substantial percentage of the best practices of the other two fully efficient departments. Further discussion on the potential improvement of the HSSD and LD are presented in the peers and weights, and virtual input and virtual output.

Peers and Weights

One of the advantages of DEA is its capacity to provide ways for weak efficient or inefficient DMUs to become fully efficient. DEA identifies peers or references for potential improvement for inefficient DMUs. These peers are fully efficient. Aside from this, DEA also provides data on the amount or percentage that the weak efficient or inefficient DMUs should consider from their peer/s. This is known as the weights. Fully efficient DMUs do not have peers and weights as they are already operating in the efficiency frontier, thus, no radial movement is necessary to perform.

The peers and weights of each inefficient department that are necessary to bring them to the efficient frontier are shown in Table 2.

TABLE 2
PEERS AND WEIGHTS OF THE FOUR DEPARTMENTS
OF CAS

Decision Making Units	Peers	Weights
BPSD	BPSD	1.00
HSSD	BPSD	0.75
LD	MADD	0.80
MADD	MADD	1.00

It could be gleaned from the table that all the fully efficient BPSD and MADD have their own department as their peers since they are already fully efficient in research. This means that they do not need peers as their references, since no radial movement or actions for improvement are required. However, they serve as references for potential improvements of the inefficient departments.

To become fully efficient, HSSD needs to examine the best practices in research of the BPSD which is its peer. Moreover, HSSD is recommended to adopt 75% of the practices of BPSD. On the other hand, it is recommended for the LD to benchmark on the best practices of the MADD being its peer. Further, LD needs to consider implementing in their department some preeminent practices in the research operations of the MADD to pull its performance efficiency level to full efficiency.

Given these data on peers and weights, the inefficient departments may initiate a cross-analysis of the current practices of their fully efficient counterparts to evaluate and identify the root cause of their inefficiencies in research. There is a necessity for the HSSD and LD to heighten the involvement of their faculty members in research. In so doing, this may result to a higher data in the output indicators particularly on the number of completed research, and presentation, and publication of research outputs. Specific targets or projected input and output data for the HSSD and LD are presented in their virtual input and virtual output.

Virtual Input and Virtual Output

The identification of DMUs with best operating practices may lead to an improvement in the performance of all units being compared, especially those which are inefficient. The DMUs that appear efficient based on the DEA Solver definitely represent conditions of comparison and examples to be imitated by the other units. In this way, a unit might appear efficient by purposely attributing a reasonable weight only to a certain set of inputs and outputs.

In cases that some DMUs appeared off the efficient frontier, the Peers and Weights show the needed percentage of each inefficient DMU from its peers to be in the efficient frontier. This potential improvement of the inefficient DMUs is shown in Virtual Inputs/Outputs (IO) sheet.

Virtual inputs and virtual outputs provide information on the relative importance that each DMU attributes to each individual input and output, for the purpose of maximizing its own efficiency score, and at the same time improving the efficiency of those units which are weak – efficient or inefficient. Thus, this allows each unit to identify and highlight their specific competencies or strengths, at the same time, their weaknesses (Vercellis, 2009 as cited by Albay, 2014).

Table 3 shows the IO sheet of the four departments of CAS which indicates their individual potential improve-

ment in research. The figures in the first column in the input and output indicators denote the DMUs' score, while the second column contains the target or projected scores to become fully efficient. The virtual input suggests a considerable amount of decrease in the input scores while the virtual output recommends some increase in the output indicators.

TABLE 3
VIRTUAL INPUT AND VIRTUAL OUTPUT IN RESEARCH
OF THE FOUR DEPARTMENTS OF CAS

Indicators	Projected Input (-) and Output (+)			
	BPSD	HSSD	LD	MADD
Virtual Input				
1. Number of faculty	19 (19)	20 (14)	17 (12)	15 (15)
2. Number of on-going researches	7 (7)	7 (5)	13 (8)	11 (11)
Virtual Output				
1. Number of faculty involved in research	12 (12)	9 (9)	12 (12)	15 (15)
2. Number of completed researches	3 (2)	2 (2)	1 (5)	7 (7)
3. Number of research presentations	11 (11)	2 (8)	10 (26)	33 (33)
4. Number of research articles published	54 (54)	12 (41)	27 (41)	51 (51)

It can be noted from the table that the target or projected input and output values for the BPSD and MADD are the same as their scores. This is primarily the consequence of their fully efficient performance level in research. However, the HSSD and LD need to do necessary adjustments in their input and output scores to level with the efficiency scores of the BPSD and MADD. Although, the HSSD posted the highest number of faculty members and the LD has the greatest number of on-going researches, the figures do not guarantee a fully efficient performance level for both the departments. This is primarily due to the fact that the numbers do not sufficiently commensurate to their scores in the output indicators.

For both HSSD and LD, DEA results suggest that in order that the number of completed research matches with the corresponding number of on-going researches, they need to decrease the number of researches being conducted from 7 to 5 for the HSSD and from 13 to 8 for the LD. However, practically speaking, the result suggests that faculty members from the HSSD and LD must follow the indicated schedule of implementation of their research studies. On-going researches from these departments must finish the conduct of these researches based on the approved work and financial plan. It is recommended, therefore, that the research facilitators of the HSSD and LD, in coordination with the college research coordinator, must constantly monitor the progress of the individual researches in order that faculty members will be given necessary support and assistance to meet the expected completion of their research studies.

Further results reflect that the HSSD and LD need to strengthen their involvement in research in terms of presentation and publication. For the HSSD, it needs to increase its data on presentation to 300% or an equivalent increase of 6 research presentations to its current data on said indicator. As per publication, the department is highly encouraged to attain a score of 41 or an equivalent increase of 341% in order to become fully efficient. The points can be earned depending on the number of research articles and the level of the journal where these were published.

CAS Research Capability Building Training Series

The results of the analyses based on the data gathered as presented in the discussions above served as concrete bases in developing the CAS Research Capability Building Training Series for all the faculty members of the four departments of the college. The training series is composed of ten (10) series. The first nine series cover topics on writing a research proposal, data management and analysis, interpreting the results of the analyses, writing the terminal report, and dissemination of research results through presentation and publication. The last series is a special capability building program that is in a form of a writeshop which can be scheduled anytime, or as the need arises to facilitate faculty researchers in preparing their monitoring and terminal reports.

3 CONCLUSIONS

The following conclusions were made on the basis of the research findings.

The BPSD and MADD are fully efficient and have the best research practices in the CAS while the HSSD and LD are inefficient in research.

The fully efficient departments pegged their own as their peers and weights in research. Inefficient HSSD posted BPSD and inefficient LD posted MADD as their peers in research with various weights to be considered.

The fully efficient departments have no virtual input and virtual output in research while the inefficient departments have varied projected inputs and outputs.

The developed training design for the CAS Research Capability Building Training Series was based on the findings of the study. The training series covers aspects in research operations from proposal to terminal reports generation and to dissemination of research outputs through presentation and publication.

4 RECOMMENDATIONS

The study recommended that the fully efficient departments may continue implementing their current best practices in the different input and output indicators in research to sustain their fully efficient performance. For the inefficient

departments, they are encouraged to consider re-evaluating and redesigning their research programs and activities to improve their efficiency levels.

The departments are encouraged to purposively work hard to become a reference or model of efficiency in all the indicators in research. The inefficient departments may adopt the best practices in research of their counterparts for them to achieve full efficiency. Sharing of best practices between departments is highly encouraged.

Also, the four departments of CAS, particularly the inefficient ones, are encouraged to analyze their respective virtual inputs and outputs to determine their target values and percentages of decrease/increase in their inputs and outputs to maximize their efficiency in research. It would be helpful for the departments in achieving fully efficient performance in research if faculty members are well-motivated to enhance their involvement and participation in all research undertakings particularly in conducting research studies and completing these studies as scheduled. also, these studies need to be disseminated through presentation in various research conferences and publication to refereed journals.

Furthermore, the CAS Capability Building Training Series is recommended for immediate implementation to sustain the performance in research of the College of Arts and Sciences and to achieve a better research performance for all the college's departments.

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