

BEYOND THE NUMBERS: EFFICIENCY, TIME, TECHNOLOGY, AND PUBLIC VALUE IN THE ASSESSMENT OF FEDERAL UNIVERSITIES

 <https://doi.org/10.63330/aurumpub.064-016>

Luis Alves da Nóbrega Neto¹

Abstract

Efficiency measurement is a relevant instrument for the management of public universities, especially in contexts of budget constraints and increasing demands for accountability. Quantitative indicators, however, may provide incomplete representations when applied to multi-product organizations in which teaching, research, extension, innovation and public value coexist under different cost structures and time horizons. This chapter develops an original reflection based on evidence previously identified in the cases of the Center for Alternative and Renewable Energy (CEAR) and the Biotechnology Center (CBIOTEC), both at the Federal University of Paraíba. Rather than reproducing previous studies, it proposes an analytical synthesis centered on three factors that may explain gaps between measured efficiency and institutional performance: output selection, heterogeneity of production structures and the time lag between resources and results. As its main contribution, the chapter presents the Three-Dimensional Model of University Efficiency, combining relative efficiency, temporality, and institutional and public value. Data Envelopment Analysis (DEA) remains useful for assessing public expenditure provided that its results are understood as evidence conditioned by the selected variables, period and decision-making units, rather than as absolute measures of institutional merit. The chapter concludes that university assessment should combine quantitative rigor with contextual interpretation, allowing indicators to support managerial decisions without reducing the complexity of the university mission.

¹ Master's degree in Public Management and International Cooperation – UFPB
E-mail: nobreganeto@gmail.com
Lattes: <https://lattes.cnpq.br/1498730881971561>

Keywords: DEA, Federal universities, Public efficiency, Public investment, Public value, University management.

INTRODUCTION

Efficiency occupies a central position on the contemporary Public Administration agenda. Scarce resources, expanding social demands, and transparency requirements encourage managers and researchers to seek tools capable of relating the resources employed to the results achieved. In public higher education, however, this task presents an additional difficulty: a university does not produce a single good or service, but rather a simultaneous set of academic, scientific, technological, and social outcomes.

This multiproduct characteristic requires caution when interpreting any synthetic performance measure. An indicator may be technically appropriate for answering a particular question and yet fail to represent the institution's overall contribution. Measurement is not neutral with respect to the choice of variables: what is included in the model becomes visible, while what remains outside it has no effect on the calculated result.

Data Envelopment Analysis (DEA) is a well-established tool for assessing the relative efficiency of decision-making units. The method makes it possible to compare units that use resources to produce outputs by constructing an empirical frontier from the observed set itself (Charnes; Cooper; Rhodes, 1978). Its application to universities is especially attractive because it can accommodate multiple inputs and outputs, although interpretation remains conditioned by the model design.

Previous research on the Academic Centers of the Federal University of Paraíba employed an output-oriented CCR model and revealed markedly different trajectories among academic units. Two cases that were subsequently examined in greater depth proved particularly fruitful for reflection: the Center for Alternative and Renewable Energy (CEAR) and the Biotechnology Center (CBIOTEC) (Nóbrega Neto, 2020; Nóbrega Neto et al., 2026a; Nóbrega Neto et al., 2026b).

At CEAR, a high volume of capital expenditure coexisted with relatively low DEA scores over the period analyzed. At CBIOTEC, in turn, a unit initially far from the frontier subsequently developed scientific and technological outputs of social relevance that were not included among the outputs in the original model. These phenomena do not invalidate DEA; rather, they reveal that its explanatory capacity depends on the question posed, the variables selected, and the time horizon adopted.

This chapter draws on this evidence but does not seek to reproduce the previous articles. Its objective is to construct an original theoretical and analytical synthesis that helps explain why measured efficiency and institutional performance may diverge in complex university organizations. The interpretive hypothesis is that this gap may result from three elements: output selection, the temporality of results, and the heterogeneity of the production structure.

The central contribution is the proposed Three-Dimensional Model of University Efficiency, comprising relative efficiency, temporality, and institutional and public value. The model neither replaces DEA nor proposes a new mathematical estimator. It is an interpretive framework intended to improve the transition from quantitative results to managerial decisions. The expression “beyond the numbers,” which guides the title of this chapter, encapsulates this perspective: the indicator is indispensable, but its academic and managerial interpretation requires an understanding of what lies behind the score.

PUBLIC-SECTOR EFFICIENCY AND THE UNIVERSITY AS A MULTIPRODUCT ORGANIZATION

In the public sector, efficiency, efficacy, and effectiveness are related but not equivalent concepts. Efficiency focuses on the relationship between the resources employed and the outputs obtained; efficacy concerns the achievement of goals; and effectiveness shifts the analysis toward the concrete effects produced in society (Nóbrega Neto, 2020). This distinction is especially relevant in universities, where outcomes of different kinds coexist and do not always emerge within the same time horizon.

Public universities educate students, produce knowledge, conduct basic and applied research, train researchers, maintain scientific infrastructure, register intellectual property, undertake extension activities, establish cooperation networks, and help address collective problems. Any attempt to condense this diversity into a single measure inevitably requires choices and simplifications.

Brazilian studies demonstrate the diversity of DEA applications to higher education, employing different units of analysis, variables, and periods (Hammes Junior; Flach; Mattos, 2020; Alvarenga; Ohayon, 2021; Barbosa et al., 2021). This plurality is methodologically legitimate, but it reinforces the need to avoid decontextualized comparisons between results obtained under different research designs.

Relative efficiency should be understood as a relationship calculated under specific conditions. A unit positioned on the frontier is not necessarily superior across every institutional dimension. Similarly, a unit below the frontier cannot automatically be characterized as irrelevant, unproductive, or poorly managed. The score indicates relative distance within a set of units and variables; it does not constitute an absolute judgment of merit.

This precaution is particularly important when an academic unit has a mission strongly linked to research or depends on technology-intensive infrastructure. In such situations, important outputs may not be observed by the model, while invested resources may produce effects only after several fiscal years.

METHODOLOGICAL PROCEDURES AND REWORKING STRATEGY

This chapter adopts a documentary, analytical-interpretive approach based on conceptual synthesis. Its empirical basis consists of previously published results concerning the CEAR and CBIOTEC cases, both derived from the original investigation into the efficiency of public expenditure in UFPB's Academic Centers. The historical data are used as secondary evidence and are explicitly attributed to their original sources.

The reworking strategy was deliberately different from merely combining the two articles. First, the cases were treated as manifestations of a common theoretical problem rather than as independent

objects. Second, cross-cutting analytical mechanisms were identified: output visibility, temporal maturation, and production heterogeneity. Third, a new interpretive framework was formulated that did not exist in its present form in the preceding studies.

This approach is also relevant from the standpoint of academic integrity. The legitimate reuse of previously published results requires attribution of the sources and the production of an additional intellectual contribution. For this reason, figures, documentary facts, and previous findings are cited; the wording, organization, articulation of the cases, and conceptual model presented in this chapter were developed specifically for this version.

No new DEA calculation is performed, nor is causality established between investments and results. The purpose is to interpret what the historical results do and, above all, do not allow one to conclude. This delimitation prevents temporal associations from being transformed into causal relationships and preserves the relative nature of the scores.

TWO CASES, ONE ANALYTICAL PROBLEM

CEAR and CBIOTEC followed different but complementary trajectories that help explain the limitations of interpreting efficiency in isolation. In the CEAR case, the predominant issue is temporal: investments in infrastructure may be recorded before the associated academic results have fully matured. In the CBIOTEC case, the predominant issue concerns production: relevant scientific and technological outputs may exist outside the set of outputs used in the model.

Between 2016 and 2018, CEAR recorded DEA scores of 0,120, 0,213, and 0,420. From 2015 to 2018, it incurred approximately R\$ 3,76 million in capital expenditure. The contrast with the Medical Sciences Center (Centro de Ciências Médicas – CCM), which remained on the efficiency frontier and incurred approximately R\$ 1,55 million in capital expenditure, made the case particularly significant (Nóbrega Neto et al., 2026b).

CBIOTEC recorded scores of 0,145 in 2016, 0,342 in 2017, and 0,884 in 2018. This progression was accompanied by considerable growth in the number of graduates, from 8 to 20 and subsequently to 50. Subsequent research showed, however, that the unit's contribution was not restricted to undergraduate education: during the Covid-19 pandemic, activities involving research on immune response, biomarkers, peptides, specialized training, and intellectual property were documented (Nóbrega Neto et al., 2026a).

Taken in isolation, these results may suggest two paradoxes. Examined together, however, they reveal something more general: observed efficiency depends on what is measured and when it is measured. An indicator may fail to capture an outcome because it has not yet matured or because it was not included among the model's outputs.

Table 1

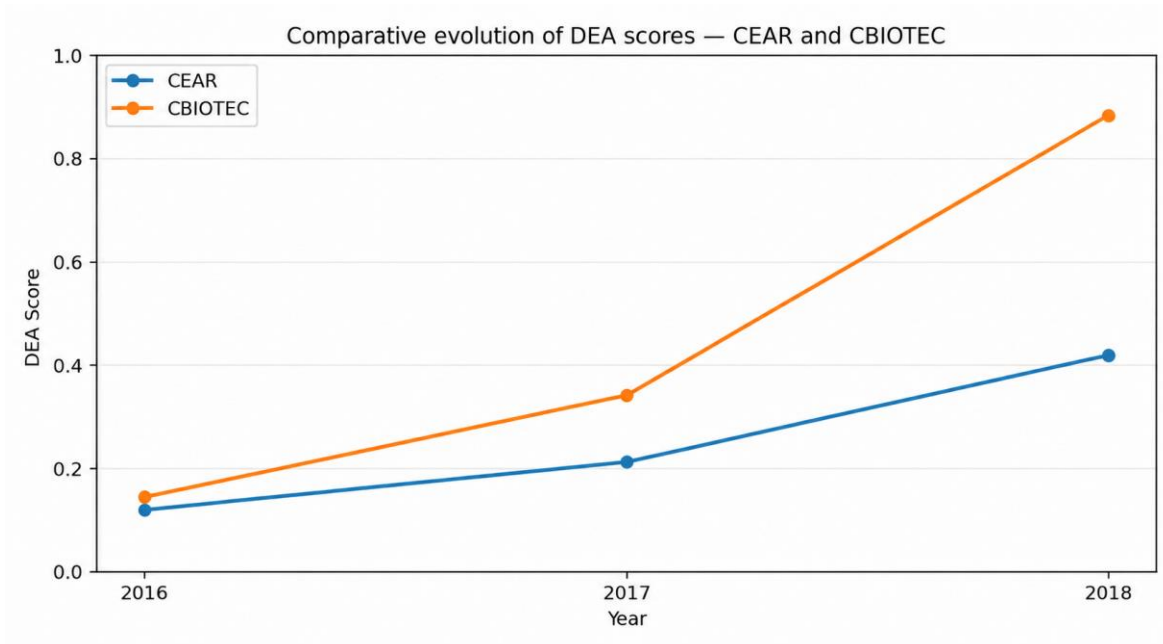
Comparative summary of the CEAR and CBIOTEC cases

Dimension	CEAR	CBIOTEC
Predominant issue	Temporal maturation of the investment	Visibility of scientific and technological outputs
DEA scores	0,120 (2016); 0,213 (2017); 0,420 (2018)	0,145 (2016); 0,342 (2017); 0,884 (2018)
Complementary evidence	R\$ 3,76 million in capital expenditure (2015–2018)	8, 20, and 50 graduates; subsequent scientific output and intellectual property
Interpretive risk	Mistaking an investment still undergoing maturation for waste	Mistaking a low score for selected outputs for low institutional value
Analytical lesson	Consider economic and academic time	Consider outputs not captured by the model

Source: Prepared by the author based on Nóbrega Neto et al. (2026a; 2026b).

Chart 1

Comparative progression of CEAR and CBIOTEC DEA scores (2016–2018)



Source: Prepared by the author based on Nóbrega Neto et al. (2026a; 2026b).

The chart shows upward trajectories for both units, although at different rates. CBIOTEC increased from 0,145 to 0,884 between 2016 and 2018, while CEAR rose from 0,120 to 0,420. This difference is descriptive and, in isolation, does not support inferences about management quality, institutional effectiveness, or return on investment, because the scores remain conditioned by the variables, units compared, and time horizon of the DEA model.

Box 1

What the chart shows—and what it does not show

What it shows	What it does not demonstrate in isolation
Annual progression of DEA scores	Overall management quality
Relative movement toward the model frontier	Social effectiveness or public value
Different rates of progression among the units	Causal return on investment
Results conditioned by the research design	Institutional superiority of one unit over the other

Source: Prepared by the author (2026).

TIME AS A HIDDEN VARIABLE OF EFFICIENCY

Budget execution is recorded according to fiscal years; academic and scientific production, however, follows its own cycles. This difference creates an asymmetry between the accounting time of expenditure and the institution's production time. Expenditure may be recognized immediately, while the associated benefit is distributed over several years.

In technology-intensive units, the sequence between resources and results may involve acquisition, installation, testing, training, incorporation into teaching and research activities, continued use, and only then the emergence of measurable results. The CEAR case is compatible with this logic, although the available data do not make it possible to prove causally that the investments made produced the observed progression in the scores.

The distinction between interpretive compatibility and causality is essential. The simultaneous presence of high investment and a low score does not prove waste; similarly, a subsequent improvement in the score does not prove that the investment caused it. Responsible analysis must recognize the existence of plausible hypotheses without converting them into unproven facts.

This perspective makes it possible to formulate the concept of temporal invisibility: a situation in which the potential outcome of a particular resource has not yet become observable during the measurement period. The problem does not necessarily lie in the absence of an outcome, but in the lack of synchronization between the timing of the input and the timing of the output.

An assessment policy that disregards this lag may favor units whose infrastructure is already consolidated and penalize expanding units. The managerial risk is the creation of a cycle in which a low score leads to reduced resources, the reduction restricts capacity building, and insufficient capacity makes future improvement in the indicator itself more difficult.

VISIBLE AND INVISIBLE OUTPUTS

The second form of invisibility is not temporal but production-related. An outcome may have been fully achieved and still not be included in the assessment function. This occurs when the model selects a legitimate but partial set of outputs.

In the original study, the number of graduates from on-campus undergraduate programs played a central role. This choice made it possible to address the relationship between resources and the production of graduates, but it was not intended to measure the full range of university production. A limitation arises only when the specific result is interpreted as a comprehensive portrayal of the institution.

CBIOTEC provides concrete evidence of this distinction. Its documented scientific activities during the pandemic included research related to the immune response to SARS-CoV-2, the training of specialized human resources, and technological development. Patent application BR 10 2024 016099-1, concerning the development of a SARS-CoV-2 immunogenic polypeptide and its applicability, embodies a scientific production chain that was not represented by the graduate output (INPI, 2024; Nóbrega Neto et al., 2026a).

Production invisibility may be defined as a situation in which a particular institutional outcome exists but does not affect the indicator because it falls outside the set of outputs considered. The invisibility belongs to the instrument, not to the output. This distinction prevents the absence of measurement from being mistaken for the absence of production.

This issue is decisive in universities because teaching, research, extension, and innovation are not independent activities. Infrastructure supporting undergraduate education may also support research; researchers trained in graduate programs may contribute to innovation; and scientific projects may generate knowledge whose social impact emerges only in response to future demands.

PRODUCTION HETEROGENEITY AND TECHNOLOGICAL INTENSITY

Intra-institutional comparison reduces some of the differences found in studies comparing universities, because the Centers are subject to the same central administration and common budget rules. Nevertheless, it does not eliminate academic heterogeneity. Programs in engineering, health, the humanities, or technology may require very different combinations of personnel, laboratories, equipment, and infrastructure.

At CEAR, the presence of Electrical Engineering and Renewable Energy Engineering programs helps explain the need for specialized laboratories and equipment. Technological intensity does not automatically justify any level of expenditure, but it is a contextual variable that must be considered when interpreting the relationship between resources and outputs.

Another consideration is obsolescence. Technological equipment may require updating over shorter cycles than traditional physical infrastructure. Capital expenditure therefore represents more than expansion; it may reflect the renewal of existing capacity. A model that observes only the volume of resources and the number of graduates does not, by itself, distinguish among foundational investment, technological replacement, capacity maintenance, and expansion.

These differences suggest that formal comparability between units does not eliminate the need for substantive comparability. The question should not be limited to whether two units belong to the same university, but should also consider whether their production functions are sufficiently similar to make direct interpretation of their scores appropriate.

THREE-DIMENSIONAL MODEL OF UNIVERSITY EFFICIENCY

The synthesis of the cases makes it possible to propose an interpretive framework comprising three dimensions. The first is relative efficiency, which preserves the quantitative result produced by DEA. The second is temporality, intended to determine whether inputs and outputs belong to compatible

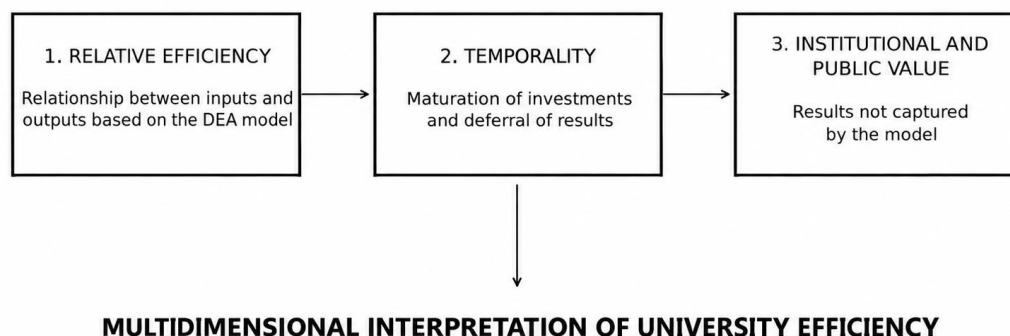
maturation cycles. The third is institutional and public value, aimed at identifying relevant outcomes not incorporated into the model.

The first dimension answers the following question: what relationship between resources and outputs was observed under the adopted design? The second asks: have the resources employed had sufficient time to produce the expected results? The third asks: are there relevant institutional outputs that are not represented by the selected set of outputs?

These dimensions should not be combined into an arbitrary score. The objective is not to create a new grade, but to organize interpretation. The advantage of the framework lies precisely in preventing a precise quantitative measure from being converted into an excessively broad institutional conclusion.

Figure 1

Three-Dimensional Model of University Efficiency



Quantitative diagnosis → Contextualization → Management decision based on evidence

Source: Prepared by the author (2026).

Table 2*Proposed interpretive matrix*

Relative efficiency	Temporality	Outcomes not captured	Managerial interpretation
Low	Recent investments	Low/not identified	Investigate maturation and operational efficiency
Low	Mature investments	Low	Examine the causes of performance and capacity utilization in greater depth
Low	Any stage	High	Possible underrepresentation by the selected set of outputs
High	Mature investments	High	Consistent performance across multiple dimensions
High	Recent investments	Not assessed	Avoid inferring future sustainability without monitoring

Source: Prepared by the author (2026).

FROM MEASUREMENT TO DECISION-MAKING: AN ANALYTICAL SEQUENCE

The main managerial consequence of the proposed model is the separation of measurement from decision-making. A DEA score should initiate an investigation, not conclude it. Moving directly from a number to an allocation decision disregards information that may be essential to understanding the unit.

A more prudent analytical sequence can be organized into five stages: measuring relative efficiency; identifying the unit's production structure; determining the stage of investment maturation; mapping relevant outcomes not incorporated into the model; and, finally, interpreting the body of evidence to inform decision-making.

This logic changes the managerial question. Rather than asking only which unit is efficient, the analysis asks why a particular unit achieved that result, what resources explain its position, which outputs are being observed, and which remain outside the measurement framework.

This shift is important because the same position below the frontier may require different administrative responses. In one case, it may reveal an operational problem. In another, it may reflect recent capacity expansion. In another, it may result from a more capital-intensive production function. In yet another, it may coexist with substantial scientific production not captured by the model.

IMPLICATIONS FOR RESOURCE ALLOCATION

Efficiency is an important dimension of resource allocation, but it should not operate as an automatic distribution rule. If efficient units necessarily received more resources and units below the frontier were systematically penalized, preexisting inequalities in capacity could be reinforced.

A consolidated unit may perform well in the present because it uses infrastructure financed in earlier periods. A new unit may require capital precisely to build the foundation that will enable it to increase productivity. Comparing only current expenditure and contemporaneous outputs may obscure this historical difference.

This does not mean abandoning efficiency criteria. On the contrary, it means making them more demanding. Investments should be monitored in terms of their installation, use, maintenance, and production of results. Contextual analysis is not permission to spend without evaluation; it is a mechanism for evaluating expenditure in a manner consistent with its nature.

An evidence-based governance policy may combine DEA indicators with information on laboratory use, the age and suitability of equipment, scientific production, graduate education, funded projects, extension, intellectual property, and other outcomes aligned with the mission of each unit.

EFFICIENCY, EFFECTIVENESS, AND PUBLIC VALUE

Incorporating public value broadens the analysis without eliminating economic rationality. The public sector must make appropriate use of collective resources, but the purpose of that use is not to produce indicators; it is to produce socially relevant goods, services, and effects.

In the university context, public value can take forms that are not immediately reflected in the number of graduates. Research may produce knowledge needed to address a public health emergency; a technology may generate intellectual property; an extension project may reach specific social groups; and advanced training may strengthen national scientific capacity.

The methodological challenge is to recognize these dimensions without turning assessment into a purely subjective exercise. The proposal is therefore not to replace quantitative indicators with narratives, but to combine verifiable measures with institutional analysis. Publications, patents, projects, degree recipients, external funding, and extension outcomes can be documented and, where appropriate, incorporated into complementary models.

The concept of public-value-oriented efficiency encapsulates this position: seeking the best possible use of resources without losing sight of the institutional purpose that justifies their allocation. Efficiency remains a fundamental means; effectiveness and public value help clarify the purposes for which, and the people for whom, resources are employed.

METHODOLOGICAL IMPLICATIONS FOR FUTURE RESEARCH

The first research agenda arising from this synthesis concerns the temporal dimension. Future studies may test lags between investment and results, relating resources invested in a particular fiscal year to outputs observed in subsequent periods. This strategy would make it possible to determine whether some of the observed gaps result from maturation and which time interval best represents each type of investment.

The second agenda consists of progressively broadening the outputs. A basic model may prioritize undergraduate education; complementary models may incorporate graduate education, scientific production, innovation, external funding, and extension. Comparing the frontiers would make it possible to observe which units are most sensitive to the definition of output.

The third agenda concerns alternative DEA models. The use of BCC, SBM, and Malmquist indices may offer additional perspectives on returns to scale, slacks, and productivity over time. These alternatives do not, by themselves, guarantee a comprehensive representation of the university, but they broaden the analytical repertoire.

The fourth agenda concerns the formation of more homogeneous comparison groups. Technology centers may be compared with units having similar profiles at other universities, thereby reducing differences in their production functions. The same reasoning may be applied to centers specializing in health, the humanities, and basic sciences.

Finally, the challenge of operationalizing public value remains. The development of indicators of social contribution, innovation, and institutional response capacity requires caution, validation, and transparency. Difficulty in measuring these dimensions should not lead to their automatic exclusion, but neither does it justify the adoption of weak metrics merely to broaden the model.

LIMITATIONS

This chapter works with historical evidence derived from previous research and does not seek to describe the current situation of CEAR or CBIOTEC. The scores used refer to the period from 2016 to 2018, while the capital expenditure data for the CEAR case cover 2015 to 2018. Any contemporary interpretation would require updated empirical data.

Nor does the chapter demonstrate a causal relationship among investment, scientific production, and efficiency. The analysis identifies plausible mechanisms and constructs an interpretive framework. Causal or longitudinal tests would require a specific methodological design and longer time series.

Another limitation arises from the synthesis of only two cases. Although the mechanisms identified may be relevant to other university units, their generalization should be treated as a hypothesis to be tested. Different institutions have their own missions, structures, and regulatory environments.

FINAL CONSIDERATIONS

A joint reading of the CEAR and CBIOTEC cases shifts the debate from two specific paradoxes to a general issue in university assessment. CEAR demonstrates that the timing of an investment and the

timing of its results may not coincide. CBIOTEC demonstrates that relevant outcomes may exist beyond the set of outputs selected for measurement.

A central conclusion emerges from this articulation: observed efficiency is inseparable from what is measured, when it is measured, and the context in which production occurs. Recognizing this condition does not weaken DEA. On the contrary, it protects the method against interpretive uses that exceed what it actually demonstrates.

The Three-Dimensional Model of University Efficiency proposes that every quantitative result be interpreted in light of relative efficiency, temporality, and institutional and public value. The first dimension preserves measurement rigor; the second incorporates the maturation cycle; and the third broadens the visibility of university outputs.

The two cases also suggest that good governance should not choose between numbers and context. High-quality public decision-making requires both. Indicators make it possible to compare, identify deviations, and formulate questions; institutional analysis makes it possible to understand why those deviations exist and which administrative response is appropriate.

In summary, CEAR demonstrates that investment may precede results; CBIOTEC demonstrates that results may extend beyond an indicator. Together, they reveal that assessing university efficiency requires calculation, contextualization, and interpretation. It is through this combination that measurement ceases to be a mere classification and becomes a tool for learning, governance, and evidence-based decision-making.

AUTHORSHIP, AUTHORIZATION, AND ORIGINALITY NOTE

This chapter is an original and unpublished work developed from issues and evidence previously examined in two jointly authored scientific publications on the CBIOTEC and CEAR cases. All coauthors of those publications expressly authorized the preparation and publication of this new chapter exclusively under the name of the lead author, Luis Alves da Nóbrega Neto. This authorization applies to the present

derivative work and does not alter, transfer, or remove authorship of the original publications, which remain fully acknowledged and duly referenced. This chapter does not reproduce the previously published texts: it presents new wording and organization, integrates the cases, develops the concepts, and advances an original analytical proposition while preserving appropriate attribution of the preceding sources.

REFERENCES

- Alvarenga, Franciane de Oliveira; Ohayon, Pierre. Relative efficiency of Brazilian federal universities in teaching, research and extension activities. *Contabilidade Vista & Revista*, v. 32, n. 2, 2021. DOI: 10.22561/cvr.v32i2.5963.
- Barbosa, Karla Marisa Fernandes et al. A eficiência dos gastos públicos com ensino superior nas universidades federais brasileiras no período de 2008 a 2018 [The efficiency of public expenditure on higher education at Brazilian federal universities from 2008 to 2018]. *Desenvolvimento em Questão*, v. 19, n. 57, p. 156–173, 2021. DOI: 10.21527/2237-6453.2021.57.11854.
- Brasil. Constituição (1988). *Constituição da República Federativa do Brasil de 1988* [Constitution of the Federative Republic of Brazil of 1988]. Brasília, DF: Presidência da República, 1988.
- Charnes, Abraham; Cooper, William W.; Rhodes, Edwardo. Measuring the efficiency of decision making units. *European Journal of Operational Research*, v. 2, n. 6, p. 429–444, 1978. DOI: 10.1016/0377-2217(78)90138-8.
- Hammes Junior, David Daniel; Flach, Leonardo; Mattos, Luísa Karam de. The efficiency of public expenditure on Higher Education: a study with Brazilian Federal Universities. *Ensaio: Avaliação e Políticas Públicas em Educação*, v. 28, n. 109, p. 1076–1097, 2020. DOI: 10.1590/S0104-40362020002802573.
- Instituto Nacional da Propriedade Industrial. *Revista da Propriedade Industrial* [Industrial Property Journal]. Pedido BR 10 2024 016099-1: Desenvolvimento de polipeptídeo imunogênico do

SARS-CoV-2 e sua aplicabilidade [Application BR 10 2024 016099-1: Development of a SARS-CoV-2 immunogenic polypeptide and its applicability]. Rio de Janeiro: INPI, 2024.

Nóbrega Neto, Luis Alves da. *A eficiência do gasto público na educação superior: uma análise da execução orçamentária da UFPB no período de 2015 a 2018* [The efficiency of public expenditure on higher education: an analysis of UFPB budget execution from 2015 to 2018]. 2020. Master's thesis (Mestrado em Gestão Pública e Cooperação Internacional) – Universidade Federal da Paraíba, João Pessoa, 2020.

Nóbrega Neto, Luis Alves da. Eficiência e alocação de recursos públicos no ensino superior: evidências dos Centros de Ensino de uma Universidade Federal Brasileira [Efficiency and the allocation of public resources in higher education: evidence from the Academic Centers of a Brazilian federal university]. *Revista Tópicos*, Rio de Janeiro, v. 4, n. 36, 2026.

Nóbrega Neto, Luis Alves da et al. O paradoxo CBIOTEC: os limites da mensuração da eficiência pública diante da produção de valor social durante a pandemia de Covid-19 [The CBIOTEC paradox: the limitations of public-sector efficiency measurement in the production of social value during the Covid-19 pandemic]. *Revista Tópicos*, Rio de Janeiro, v. 4, n. 36, 2026a. DOI: 10.70773/revistatopicos/787962653.

Nóbrega Neto, Luis Alves da et al. O paradoxo do “Caso CEAR”: entre a intensidade tecnológica e a fronteira de eficiência na gestão universitária [The “CEAR Case” paradox: between technological intensity and the efficiency frontier in university management]. *Revista Tópicos*, Rio de Janeiro, 2026b. DOI: 10.70773/revistatopicos/788996403.

Universidade Federal da Paraíba. Centro de Biotecnologia. *Histórico de Criação e Desenvolvimento* [History of its establishment and development]. João Pessoa: UFPB, 2011.

Universidade Federal da Paraíba. Centro de Biotecnologia. *Pesquisadora do CBIOTEC está entre os 12 contemplados no edital para combate à Covid-19 submetido ao BRICS* [CBIOTEC researcher is

among the 12 selected under the BRICS call for proposals to combat Covid-19]. João Pessoa: UFPB, 2021.