

## Research Article

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## Optimizing Vocational Education Management: A Study on Indonesian State Vocational High Schools

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### Abstract

**Background/purpose.** This study aims to evaluate the performance of State Vocational High Schools (SMK) with the status of Regional Public Service Agency at the provincial level. This assessment is conducted out to determine how efficiently schools employ their resources and generate the best performance possible. It is expected that the findings of this study would help authorities enhance management at schools, increase partnerships with the industry, and make students more competitive in the job market.

**Method/ Material.** The approach used in this study is Data Envelopment Analysis (DEA) to measure the relative efficiency of 30 schools. Three input factors and four output variables—obtained through school surveys and interviews—were employed in this research.

**Result.** The study revealed that 11 of the 30 SMKs analyzed achieved the highest efficiency level (score 1). These schools displayed the most efficient use of resources in producing output. Three of the eleven schools were chosen as the primary models to serve as pilot projects in an effort to improve management efficiency in other SMKs.

**Conclusion.** Policymakers can improve the efficiency of school management by adopting the study's conclusions. Schools may raise the competitiveness of graduates by making the most use of their resources, fostering stronger relationships with industry, and making the curriculum more relevant to the workplace. At the provincial and national levels, efficient school models may function as a model for creating vocational education policies.



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## 1. Introduction

Vocational education, particularly at the Secondary Vocational High School (SMK) level, has an important part in preparing trained and employable human resources, which is one of the keys to capitalizing on the demographic bonus potential (Susantiningrum et al., 2023). Vocational education, which emphasizes mastering applicable skills and expertise, is crucial for a nation's social and economic development in addition to boosting individual competitiveness (Suharno et al., 2020). Previous research has demonstrated that nations with strong systems of vocational education typically have an edge in establishing long-term social and economic stability (Cedefop, 2023; Dixit & Ravichandran, 2023). This makes vocational education a vital foundation for boosting innovation, enhancing economic resilience, and producing jobs that meet the demands of the global economy (Paudel et al., 2025).

The distinctive aspects of vocational education include an emphasis on knowledge and practical skills that are pertinent to the demands of the workplace, particularly in the commercial and industrial sectors (Harini et al., 2023; McGrath & Yamada, 2023; Zylfija & Shaqiri, 2023). An industry-based learning strategy, like a teaching factory (TEFA), simulates a real work setting so that students can become accustomed to thinking and working with high standards, much like they would in the business (Huang et al., 2023; Yoto, Marsono, et al., 2024). Knowledge transfer is only one aspect of this education; other aspects include mastering real assignment (Rintala & Nokelainen, 2020), developing a professional work culture (Pambayun et al., 2023; Ramasamy & Mengling, 2024; Skiba, 2020), and being able to adjust to the changing demands of the workplace (Barliana et al., 2020).

The link-and-match concept, which strives to enhance vocational education's quality and accessibility in a comprehensive way, is the basis of SMK (Ariansyah et al., 2024; Yoto, Suyetno, et al., 2024). The objectives of quality improvement are to manage human resources to assist graduates who are prepared for the workforce, increase the competency of teachers, and provide learning that is pertinent to the demands of the workplace (Arinaitwe, 2021; Njenga, 2023; Paoprasert et al., 2024; Sucipto et al., 2024). Furthermore, the implementation of teaching factories, strategic planning, efficient management, and cooperation with the business and industrial sectors are all necessary to improve the governance of vocational schools (Khurniawan et al., 2021; Rohaeni et al., 2021; Rosidi et al., 2024; Silliman & Virtanen, 2022). Vocational education may also be made more accessible to all societal levels and become more sustainable, high-quality, and relevant with sound governance (Kibrit et al., 2022; OECD, 2023).

Strengthening institutional governance is the primary factor in raising the quality of SMK (Hrmo et al., 2016). The ability of vocational education to meet the demands of the regional and international labor markets can be achieved by efficient governance and a modern system of management (McGrath & Yamada, 2023). These initiatives include enhancing teacher competency (Huo, 2023; Liu et al., 2024), creating a curriculum that is pertinent to industry demands (Gupta et al., 2024; Magagula & Awodiji, 2024), and offering the newest technology-based infrastructure (Ghosh & Ravichandran, 2024; Magagula & Awodiji, 2024; Thomann et al., 2024). Creating graduates who are capable, flexible, and creative also requires collaboration with industry and the establishment of an extensive quality assurance system (OECD, 2023; Tran, 2021). Therefore, improving institutional governance may serve as a basis for SMK to increase its contribution to the competitiveness of the national economy.

In Indonesia, there are both state and private SMK. President Regulation Number 68 of 2022 for the Revitalization of Vocational Education emphasizes the significance of revitalizing the vocational education system through partnerships with businesses and industries in order to improve the quality of vocational education. As outlined in the Regulation of the Minister of Home Affairs Number 79 of 2018, one practical approach is the adoption of the Regional Public Service Unit (BLUD) state SMK

model. To establish a fully autonomous and independent SMK, BLUD is expected to give vocational schools financial management flexibility that also permits transparent and responsible administration.

Despite the increasing adoption of the BLUD model in Indonesian SMKs, there remains a significant gap in understanding its actual impact on educational quality, governance efficiency, and graduate employability. Most studies focus on theoretical frameworks and policy discussions, but empirical evaluations that assess the effectiveness, challenges, and sustainability of BLUD implementation in diverse contexts are scarce. Additionally, comparative studies between BLUD and other vocational education governance models are lacking, making it difficult to determine its relative advantages. There is also limited research capturing the perspectives of key stakeholders—including school administrators, educators, students, and industry partners—which are crucial for refining the policy. Furthermore, given Indonesia's diverse economic and educational landscape, regional disparities in BLUD implementation have not been thoroughly examined. Addressing these gaps, this study seeks to provide a comprehensive evaluation of the BLUD model in Indonesian vocational schools, offering insights that can guide future improvements in vocational education governance and policymaking.

Therefore, in order to make sure that the policy's implementation stays in line with its goals, the authors were interested in investigating an evaluation study of state SMK conducted employing the BLUD model in Indonesia. Local governments may find out how much financial management adaptability and accessibility have raised the standard of education at the SMK by conducting a comprehensive evaluation. Additionally, the assessment assists in identifying any barriers or difficulties addressed. The evaluation's findings can serve as a platform for continual improvements and additional policies, making the BLUD model more than just a tool for financial management; it can also serve as a driving force behind the establishment of more creative, independent, and highly competitive SMK that can generate highly competitive graduates.

## 2. Literature Review

### 2.1. Vocational School and Badan Layanan Umum Daerah (BLUD) in Indonesia

Previous studies have been conducted to evaluate vocational school performance. These include studies conducted in China (Li, 2024), Turkey (Uzmanoğlu et al., 2010), South Korea (Choi, 2021), Netherland (Jenniskens et al., 2023), Portugal (Sarrico & Rosa, 2009), Estonia (Ploom & Haldma, 2013), Marocco (Goumairi et al., 2020), Thailand (Chalapati & Chalapati, 2020), Brazil (Uemura & Comini, 2022), Malaysia (Deraman et al., 2002), Japan (Ogawa, 2023), and Switzerland (Latina & Ramirez, 2017). Special comparison studies have also been conducted out, such those between Japan and Jordan (Alomari et al., 2019), Thailand and Japan (Tangthongtongkul, 2016), Nigeria and Ghana (Ogundele & Oyelade, 2018), Iceland and Slovenia (Ursula Renold et al., 2018), Indonesia and Malaysia (Purwanto et al., 2024), and also a comparative analysis of Australia, UK, USA, and Germany (Peters, 2021).

Previous studies on vocational school performance across various countries have highlighted key aspects such as governance, industry collaboration, curriculum relevance, and graduate employability. Research from China, South Korea, Switzerland, and the Netherlands emphasizes the effectiveness of vocational education in preparing students for the labor market, while studies in Portugal and Estonia focus on governance models and policy implementation. Comparative analyses, such as those between Japan and Jordan or Australia, the UK, the USA, and Germany, provide insights into different vocational education frameworks and best practices. Additionally, studies from Morocco, Brazil, and Malaysia highlight challenges like funding limitations, teacher competency, and alignment with industry demands. While these studies contribute valuable knowledge, research on Indonesia's Regional Public Service Agency (BLUD) model remains scarce, particularly regarding its

impact on financial flexibility, institutional governance, and vocational school sustainability. This gap underscores the need for further investigation into BLUD's effectiveness in enhancing vocational education outcomes in Indonesia.

Indonesia, with a population of 339,721 SMK teachers in 14,253 SMK institutions, and of about 5,059,800 students in 2023 (Pusdatin, 2023) have a high potential to develop into a talented, competitive, and competent workforce from an early age, prepared to work in their industries (Ariansyah et al., 2024). Textiles and clothing, automotive, electronics, chemicals, and pharmaceuticals are the five priority sub-sectors that are specifically mapped off, according to the national long and middle-term development planning 2020-2024 strategy. According to the Minister of Education, Culture, Research, and Technology's Decree Number 56/M/2022 concerning Guidelines for Implementing the Curriculum in the Framework of Learning Recovery, SMK has ten areas of expertise: 1) Construction and Property Technology; 2) Manufacturing and Engineering Technology; 3) Energy and Mining; 4) Technology and Information; 5) Health and Social Work; 6) Agribusiness and Agrotechnology; 7) Maritime; 8) Business and Management; 9) Tourism; 10) Arts and Creative Economy.

BLUD is an embodiment of the concept of new public management (Denhardt & Denhart, 2007; Hood, 1991), including adopting private/business sector management styles into the public sector (Sun et al., 2024; Zidonis et al., 2020), performance standards and achievement measures (Castelo & Gomes, 2024; Haug et al., 2024; Hermanu, Sari, Sondari, et al., 2024), decentralization and work unit breakdown (Rahman et al., 2023), competent management in the public sector (A. J. Ali et al., 2021; Lindaas et al., 2024), competition in the public sector (Sun et al., 2024; Vivona et al., 2024), a stronger focus on output and outcome control (Y. Ali & Haliah, 2021; Lapuente & Van de Walle, 2020), and resource conservation (Boe & Kvalvik, 2015; Sun et al., 2024). The implementation of New Public Management is an ideal possibility for the local government to evolve into more flexible and responsive to market demands.

Government Regulation No. 38 of 2007 states that the Provincial Government has the competence to administer (including finance) secondary education, including the management of 3,740 state vocational schools. State SMKs' acquisition of BLUD status is a determined move to increase educational standards in accordance with the relevant regulations. Financial management flexibility allows BLUD SMKs to independently manage revenue and expenses according to the activities and programs specified in the budget and business plan. Without needing to be regularly provided into the local government, operational income acquired through service, collaboration with other parties, or other enterprises can be utilized immediately to assist raising the standard of education services. Schools can also choose their own service costs and wages for staff members, which may assist to increase the well-being and output of teachers.

The objective is that implementing BLUD status in educational institutions will be a strategic move toward improving education quality through flexible finance management. However, the adoption of BLUD has not occurred smoothly due to schools' lack of understanding of BLUD administration (Auliya & Firmanto, 2020). Most schools are unprepared to meet the new policy's standards, which is a severe barrier in achieving output targets and maintaining educational service quality (Hariyanto, 2021). Furthermore, insufficient human and financial resources impede the implementation of remuneration plans intended at enhancing the welfare of teachers and school personnel (Sutikno et al., 2018). This problem is made worse by a lack of knowledge about BLUD governance and a lack of socialization with strategic documents like budget and Strategic Plans (Sukirno et al., 2019). To ensure the success of BLUD implementation in this setting, the Education Office, the Regional Financial and Asset Management Agency (BPKAD), and local governments play a crucial role in offering support and training (Chou et al., 2010).

Considering the challenges, the BLUD system's adaptability offers excellent chances for improving school operating income. Learning activities and the construction of educational facilities can be directly supported by revenue from production units, partnerships with other enterprises, and industry. However, because operating income is still restricted to production units exclusively, this potential has not yet been completely realized (Rosydiana, 2023). BLUD Vocational Schools may develop higher-quality educational services and enhance the welfare of school residents by putting the circular economy concept into practice and designing a compensation plan that conforms with regulations.

BLUD at SMK encourages transparency and responsibility in management in compliance with the Ministry of Internal Affairs regulation number 61 of 2007 and number 79 of 2018. This transparency involves both financial and non-financial aspects, with accountability not only to internal school stakeholders but also to the public. Financial accountability comprises the transparent reporting of income, expenses, assets, and equity.

While financial accountability, which includes the transparent reporting of income, expenses, assets, and equity, is interesting to evaluate, non-financial accountability is also important. The management responsibilities of BLUD managers in SMK with the BLUD model (BLUD SMK), including school programs, activities, and policies from the planning, implementation, monitoring, and evaluation stages, are crucial to improving the quality and relevance of learning in vocational schools.

The BLUD model also provides vocational schools more flexibility in managing their resources, enabling them to do so more autonomously and effectively. How to adapt the growing student and teacher numbers to the present capacity and educational requirements is one of the most significant challenges facing school administration. The growth of teaching staff is not only about numbers; it also requires more competency and an equitable assignment of responsibilities. An increase in students can lead to classroom congestion, which impairs learning effectiveness, and the addition of unguided teachers may affect school management effectiveness if it is not adequately addressed.

To ensure for sure that the development has a beneficial effect on the quality of education, the number of students and teachers is a crucial component that needs to be examined when assessing school performance. With BLUD SMK's financial flexibility, schools can create more flexible management plans, like expanding their partnerships with industry and business, building more classrooms and better facilities to support teaching factories, or training teachers to better meet the demands of an expanding student body. Policies that promote teaching effectiveness must be balanced with the growth of students, and the addition of teachers must be planned methodically to ensure their best performance. Therefore, schools have a better chance to strategically manage the increase in the number of students and teachers through the BLUD model, which can help to improve overall school performance.

Senior high schools, particularly vocational schools, strive to improve performance and efficiency, but due to the complexity of technical and non-technical aspects, as well as the numerous demands and expectations in other missions such as improving teacher quality, improving industrial cooperation, and improving teaching factories, as well as things like financial transparency, as well as aspirations from school residents. It is crucial to measure the effectiveness of governance reforms to evaluate how well BLUD SMK's performance is evolving. In the long run, this evaluation will increase knowledge and creativity in society by generating detailed data that can be utilized for strategic planning, performance monitoring, resource allocation, quality control, and policy creation (Hermanu et al., 2025).

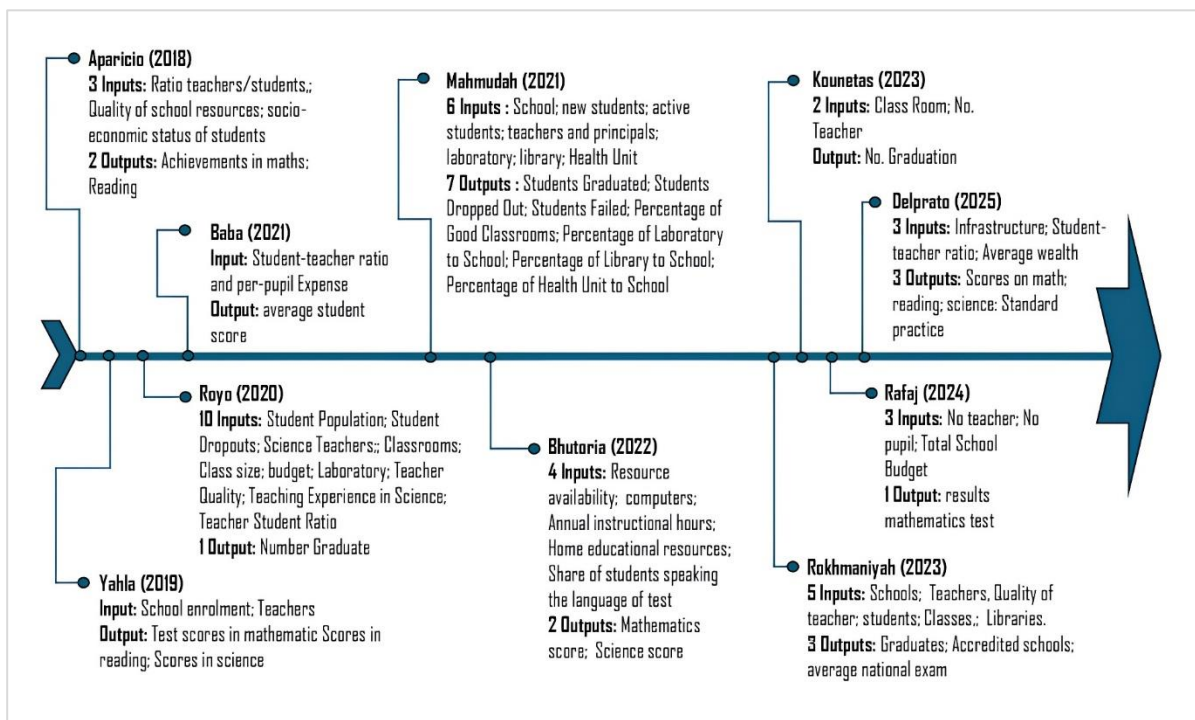


## 2.2. Efficiency

To assess the effectiveness and efficiency of research-based community service initiatives Data Envelopment Analysis (DEA) was employed, it demonstrates how DEA may be used to examine efficiency, even in public institution (Sondari et al., 2024; Wang et al., 2021). DEA is one of the most commonly used methodologies in the assessment of government organization efficiency (Abbott & Doucouliagos, 2003), and it focuses on overcoming efficiency challenges that complex organizations meet while creating multiple outputs from multiple inputs simultaneously (Hermanu, Sari, Muzakir, et al., 2024). The DEA contributes to the primary goal of this study, which is to examine the efficiency of viewing SMK performance when utilizing the BLUD model.

Charnes developed the nonparametric DEA model in 1974 with the objective of evaluating the Decision-Making Unit's (DMU) efficiency. The "standards of excellence" are applied to evaluate the DMU's performance to those of other comparable units in order to establish comparisons (Cooper et al., 2011). The Constant Returns to Scale (CRS)/ Charnes, Cooper, dan Rhodes (CCR) technique is the method used in this study. It assumes that as input capacity grows, output would also increase in quantity and quality, leading to a model assessment known as Technical Efficiency Value. Originally presented by Charnes et al. in 1978, the CRS model is also known as the CCR model (Charnes et al., 1978). This technique demonstrates that the input-output ratio has increased but remains constant.

We took consideration the objectives and conditions of BLUD SMKs, as well as previous studies that used DEA to establish inputs and outputs in efficiency research evaluations (Figure 1). The illustration represents several studies that reveal the efficiency and impact of resource utilization in secondary school with multi-input and multi-output identification. In each study, several inputs are examined, such as the number of students, teachers, facilities, or teacher quality, and are connected to outputs like graduation rates or academic performance scores.



**Figure 1.** Previous studies used DEA techniques

*Note: Created from many sources (Aparicio et al., 2018; Baba et al., 2021; Bhutoria & Aljabri, 2022; Delprato & Antequera, 2025; Kounetas et al., 2023; Mahmudah et al., 2021; Rafaj & Némethová, 2024; Rokhmaniyah et al., 2023; Royo et al., 2020; Yahia & Essid, 2019)*

The methodology and research techniques employed to examine these dynamics and their impact on the research findings are described in the following section. This is based on the earlier discussion of the BLUD SMK and the evaluation of BLUD SMKs' performance thus far, which compares the performance of BLUD vocational schools.

### 3. Research design and methods

#### 3.1. Research design

The objective of this study was to evaluate the implementation of the BLUD model in SMK in Indonesia to assess the suitability of the policy with the stated objectives. The investigation was conducted by comparing BLUD SMKs with adjustments in their output and input conditions after becoming BLUD SMKs.

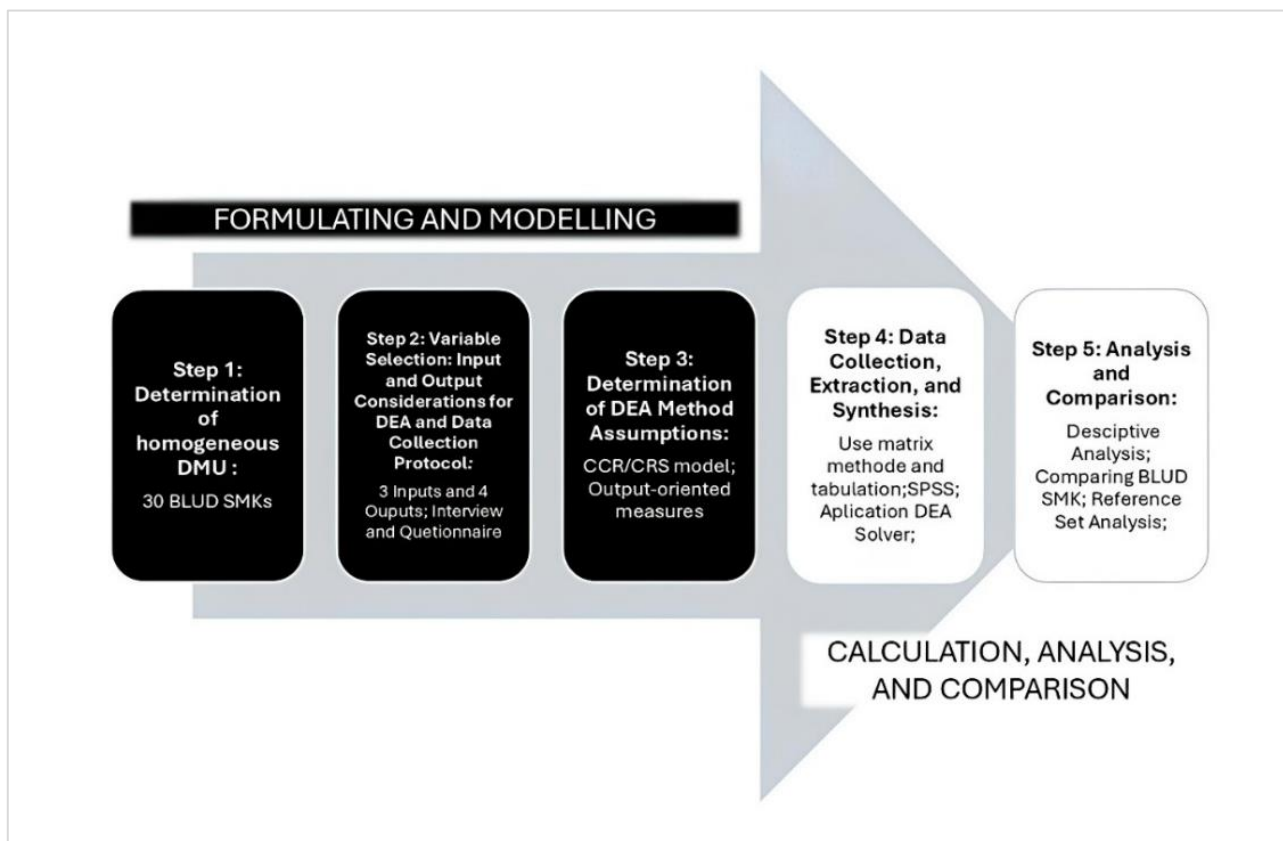


Figure 2. Research process

Note: Adapted from Dimiyati & Hermanu, 2022

The steps that have been executed are depicted in Figure 2, to answer the authors' curiosity in seeing the performance of BLUD SMK.

#### 3.2. Data collecting and Participants

We decided to establish 30 BLUD SMKs in West Java as DMUs (Table 1) as a homogeneous unit with the same role and purpose (Cooper et al., 2011). This is because the West Java Provincial Government ordered 35 state SMKs to switch to BLUD status in 2022.

**Table 1.** The number of SMK that are shifting to BLUD status in 2022

No	Province	Number of SMK
1	D.I. Yogyakarta	1
2	DKI Jakarta	1
3	West Java	35
4	East Java	1
5	West Sumatera	5
6	Bengkulu	4
7	West Nusa Tenggara	11
8	South Kalimantan	9
9	North Kalimantan	12
	Total	79

*Note: Data source from Directorate SMK, Ministry of Primary and Secondary Education*

In order to gather data, we conducted structured interviews with school principals and developed a structured questionnaire based on established measurement scales (Taherdoost, 2021). The questionnaire was designed to assess key aspects of BLUD SMK performance and was reviewed by vocational education experts to ensure content validity. A pilot study was conducted with a small group of respondents to test the clarity and reliability of the questionnaire items, and necessary modifications were made before full development. The final questionnaire was administered to teachers and school committee members across the 30 BLUS SMKs, with 332 responses collected. Reliability analysis, including Cronbach's alpha, was performed to confirm internal consistency. Additionally, we employed both primary and secondary data collection techniques, including an evaluation of SMK performance reports for the 2022 – 2023 academic year and focus group discussions to further validate the findings.

Interviews with school principals and focus group discussions were transcribed and systematically coded to identify recurring themes related to BLUD implementation, governance challenges, and best practices. The coding process involved both inductive and deductive approaches to ensure comprehensive theme development. The findings derived from qualitative data are integrated into the results section to provide deeper insights into the quantitative outcomes, offering a more nuanced understanding of the BLUD model's impact on vocational school governance.

### **3.3. Data analysis methods**

This study has three inputs and four outputs (see Table 2). To analyze efficiency, we included shifts in the number of students and teachers, as well as Financial Governance procedures, Organizational structure, Teacher dedication, Infrastructure, and School Community Support as input factors. Improvements in teacher quality and the number of vocational school partners, TEFA conditions, financial health, ease of access to financial data, and positive intentions in school communities are all output variables.



**Table 2.** Definition of input and output variables for the DEA

Variables	Condition And Definition
<b>INPUT</b>	
Increasing the number of students (I1)	Change in the number of vocational school students from pre-BLUD (2022) to BLUD status (2024) (Percentage).
Increase in the Number of Teachers (I2)	Change in the number of vocational school teachers from pre-BLUD (2022) to BLUD status (2024) (Percentage).
Response from the input variable questionnaire (I3).	Average of the variables' returned questionnaires: Financial Governance procedures; Organizational structure; Teacher commitment; Infrastructure; Support from school community.
<b>OUTPUT</b>	
Increased the number of certified teachers (O1).	Change in the number of vocational school certified teachers from pre-BLUD (2022) to BLUD status (2024) (Percentage).
Increase in partners (O2)	Change in the number of SMKs industrial and business partners from pre-BLUD (2022) to BLUD status (2024).
Teaching Factory Conditions (O3)	The TEFA's condition value is calculated using the responses of a questionnaire completed by respondents, which reflect the factory's condition.
Response to the output variable questionnaire (O4)	Average of the variables' returned questionnaires: Financial health: Ease of access to financial reports School communitys' positive intentions

*Note: For indicators that employ respondents' responses (I3, O3, O4), are described by numbers 1 through 5, where: 1 means not quite there, whereas 2 means only planning. 3 means that BJ exists but is not yet running, 4 indicates that it exists but is less optimal, and 5 is Exists Very Optimally.*

By considering the input-output ratios of DMUs, the DEA approach evaluates their comparative efficiency. We selected the inputs and outputs carefully to preserve the analysis's discriminatory strength, making sure that no superfluous components were added that would impair DEA's ability to discern between wasteful and efficient units. Three inputs and four outputs provide a sufficient degree of discrimination, with the minimum number of DMU units required to be fulfilled equal to the product of the two inputs and the number of outputs (Dyson et al., 2001). Our selection of CRS, which is considered to be more representative due to its elimination of scale variability, was driven partially by the condition of DMUs with comparable sizes, capabilities, or operational situations.

An Excel worksheet was used for the data collection process, which employed tabulation and matrixing techniques. SPSS version 25 was used for descriptive analysis. DEA examined the gathered information using the DEA Solver application. DEA Solver is a Microsoft Office application that was

created with VBA and Excel macros and works with Excel (Cooper et al., 2007). In addition to providing primal (envelopment form) and dual (multiplier form) computation results, including slacks, projections to efficient frontiers, and graphical visualizations, this tool enables users to read data straight from Excel worksheets. With its DEA-optimized linear programming approach, this application can be a useful tool for efficiency analysis and a deeper comprehension of DEA models.

We compared the efficiency of 30 BLUD SMK DMUs that were granted a Decree on status adjustments to BLUD by the West Java Provincial Government. In order to maximize output without affecting the quantity of accessible input, the DEA technique is applied with an output-oriented approach and CRS assumptions. With these presumptions, it is intended that this study will offer an objective evaluation of the performance assessment of SMK that have converted to BLUD.

Additionally, we included reference set analysis to examine how effective units might be used as benchmarks for less effective units (Agarwal et al., 2014). This enables us to identify the most efficient and often cited DMUs, ascertain the frequency with which a DMU is used as a reference for other units, and tell less efficient units about which benchmarks they might utilize as models for improvement (Lee & Kim, 2012).

#### 4. Results

A summary of descriptive statistics for inputs and outputs is provided in Table 3 for an in-depth look of the thirty DMUs. SMKN Lembang, SMKN 5 Pangalengan, SMKN 1 Kuningan, SMKN 1 Tasikmalaya, and SMKN 1 Sukabumi led the most student increase (I1), with respective percentages of 42%, 24%, 21%, 19%, and 17%. SMKN 1 Tasikmalaya, SMKN 1 Banjar, SMKN 11 Bandung, SMKN 1 Ciamis, and SMKN 1 Mundu, with percentages of 38%, 23%, 21%, 20%, and 19%, respectively, accounted for the teacher addition (I2).

**Table 3.** Descriptive statistics: inputs and outputs

	N	Minimum	Maximum	Mean	Std. Deviation
I1	30	-8.00%	42.%	6.57%	10.18%
I2	30	-29.00%	38.%	7.07%	12.18%
I3	30	3.5	5.0	4.470	0.46
O1	30	-13.00%	213.%	38.17%	44.53%
O2	30	0	104	21.93	23.60
O3	30	1	4	2.77	0.77
O4	30	2	5	4.13	0.86
Valid N (listwise)	30				

*Notes: Processed by Authors, the result have been derived through SPSS*

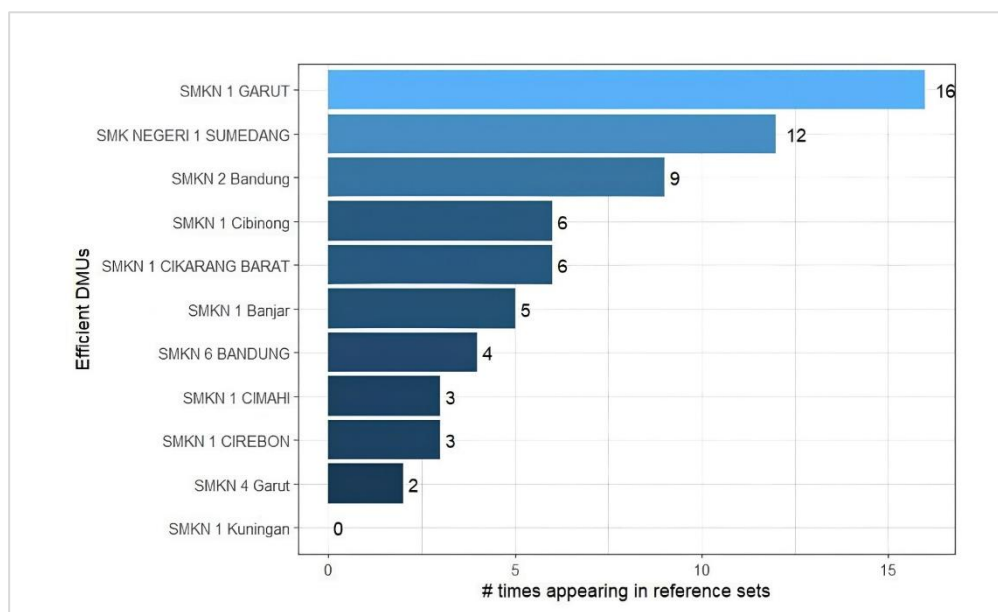
The DMUs with the highest increases in teacher certification quality (O1) are SMKN 2 Bandung, SMKN 1 Banjar, SMKN 1 Cibadak, SMKN 1 Tasikmalaya, and SMKN 5 Pangalengan. In addition, SMKN 1 Garut, SMKN 1 Cibinong, SMKN 3 Bandung, SMKN 1 Sukabumi, and SMKN 3 Bogor made great progress in partnership cooperation with industry and business (O2). Based on the results of the questionnaire, SMKN 1 Garut, SMKN 1 Cibinong, SMKN 3 Bandung, SMKN 1 Tasikmalaya, and SMKN 5 Panglengan had the best average input response (I3). SMKN 1 Garut, SMKN 1 Cibinong, SMKN 1 Tasikmalaya, SMKN 1 Cibadak, and SMKN 1 Purwakarta achieved the highest average value for output (O4), while SMKN 1 Garut, SMKN 1 Cibinong, SMKN 1 Cirebon, SMK NEGERI 9 Bandung, and SMKN 1 Tasikmalaya obtained the best response for the TEFA condition (O3).

**Table 4.** DMU Efficiency

DMU	EFFICIENCY	DMU	EFFICIENCY
SMK NEGERI 1 SUMEDANG	1.00	SMKN 1 MUNDU	0.78
SMKN 4 Garut	1.00	SMKN 1 Banjar	1.00
SMK Negeri 1 Losarang	0.75	Smkn1 kota bekasi	0.87
SMKN 1 CIKARANG BARAT	1.00	SMKN 1 Ciamis	0.94
SMKN 1 Cibinong	1.00	SMKN 1 CIMAHI	1.00
SMKN 1 GARUT	1.00	SMKN 2 Bandung	1.00
SMKN 1 Kuningan	1.00	SMK NEGERI 1 DEPOK	0.98
SMKN 1 Sukabumi Kota Sukabumi	0.87	SMKN 1 Karawang	0.84
SMKN 2 Subang	0.96	SMKN 1 Purwakarta	0.98
SMKN 1 CIREBON	1.00	SMK NEGERI 9 BANDUNG	0.83
SMKN 1 MAJALENGKA	0.91	SMKN 6 BANDUNG	1.00
SMKN PERTANIAN PEMBANGUNAN LEMBANG	0.89	SMKN 11 Bandung	0.88
SMKN 3 Bogor	0.82	SMKN 1 TASIKMALAYA	0.81
SMKN 3 BANDUNG	0.68	SMKN 5 PANGALENGAN	0.89
SMKN 2 TASIKMALAYA	0.89	SMKN 1 Cibadak	0.97

Notes: Processed by Authors, the models have been derived through DEA Solver. Models' characteristics: output-orientation; CCR/CRS

Table 4 shows the DMU efficiency because of DEA analysis. The results of efficiency measurements using the DEA CCR model revealed that 11 DMUs had a relative efficiency value of 1, whereas 19 DMUs had a relative efficiency value less than 1. DMUs having a relative value less than one are considered inefficient.

**Figure 3.** Reference Set Analysis

Notes: Processed by Authors, the models have been derived through DEA Solver. Models' characteristics: output-orientation; CCR/CRS

SMKN 1 Garut, SMK Negeri 1 Sumedang, SMKN 2 Bandung, SMKN 1 Cibinong, and SMKN 1 West Cikarang are the top 5 rankings according to the number of occurrences in the reference set, as shown in Figure 3. Due to the higher frequency of occurrences in the reference set, these SMKs are DMUs that are frequently utilized as efficiency references or benchmarks for other units. The top three of state SMK with BLUD status in West Java which has the highest level of efficiency is identified by the profile and development of several school components in table 5 as follows:

**Table 5.** A Review of BLUD SMK with the Highest DEA Score

Profile	SMK 1 Garut	SMK 1 Sumedang	SMK 2 Bandung
Students	2.543 (1% increase)	2.083 (4% increase)	1.929 (2% increase)
Teachers	135 (5% decrease)	119 (6% increase)	103 (8% increase)
Certified Teachers	73 (22% increase)	8 (33% increase)	25 (213% increase)
Areas of expertise	<ol style="list-style-type: none"> <li>1. Manufacturing and Engineering Technology;</li> <li>2. Energy and Mining;</li> <li>3. Information Technology;</li> <li>4. Health and Social Work;</li> <li>5. Business and Management;</li> <li>6. Arts and Creative Economy.</li> </ol>	<ol style="list-style-type: none"> <li>1. Construction and Building Technology;</li> <li>2. Manufacturing and Engineering Technology;</li> <li>3. Information Technology.</li> </ol>	<ol style="list-style-type: none"> <li>1. Manufacturing and Engineering Technology;</li> <li>2. Information Technology;</li> <li>3. Arts and Creative Economy.</li> </ol>
Konsentrasi Keahlian	<ol style="list-style-type: none"> <li>1. Logistics Engineering;</li> <li>2. Solar, Hydro, and Wind Energy Engineering, Software Engineering;</li> <li>3. Computer and Network Engineering;</li> <li>4. Medical Laboratory Support Services;</li> <li>5. Clinical and Community Pharmacy Support Services;</li> <li>6. Digital Business;</li> <li>7. Office Management;</li> <li>8. Accounting;</li> <li>9. Visual Communication Design.</li> </ol>	<ol style="list-style-type: none"> <li>1. Building Modeling and Information Design;</li> <li>2. Machining Engineering;</li> <li>3. Welding Engineering;</li> <li>4. Metal Fabrication and Manufacturing Engineering;</li> <li>5. Industrial Electronics Engineering;</li> <li>6. Electrical Power Installation Engineering;</li> <li>7. Software Engineering;</li> <li>8. Computer and Network Engineering;</li> <li>9. Karawitan Art.</li> </ol>	<ol style="list-style-type: none"> <li>1. Machining Engineering;</li> <li>2. Machine Drawing Design;</li> <li>3. Welding Engineering;</li> <li>4. Software Engineering;</li> <li>5. Computer and Network Engineering;</li> <li>6. Visual Communication Design;</li> <li>7. Animation.</li> </ol>
Industrial and business partners	21 to 125	12 to 18	70 to 102
Number of School Business Units	4 units (Production of banners and advertisements, and dishwashing soap, website creation services, and mini markets)	6 units (LED lighting, performing arts, welding products, vehicle service, and digital product design)	7 units (Welding services)
Number of TEFA	4	2	3

Notes: compiled by Authors, from the survey

## 5. Discussion

According to further data from the survey, the financial management process at SMKN 1 Sumedang still need improvement, although SMKN 1 Garut has a more organized process with well-defined SOPs. SMKN 2 Bandung is excellent in coordinating and involving its administrative and teaching staff in terms of organizational structure. SMKN 2 Bandung and SMKN 1 Garut appear to have more dedicated teachers to BLUD management, whereas SMKN 1 Sumedang needs to boost teacher involvement. The infrastructure of SMKN 2 Bandung is more favourable, especially when it comes to the banking system's digitization. While SMKN 1 Garut needs to enhance communication with parents and the school committee to increase trust in the school, SMKN 2 Bandung has more obvious support from the school community for financial transparency.

There are differences in how fundamental governance concepts are applied in the three schools' BLUD finance management. A more mature preparedness to adopt a BLUD-based financial system is demonstrated by SMKN 2 Bandung in terms of comprehending the BLUD financial concept. Optimizing internal control systems is one of the many areas that still require improvement. When it comes to creating financial management plans and standard operating procedures, SMKN 1 Garut has a more structured governance structure. To make its financial management system more targeted and useful as a decision-making tool, SMKN 1 Sumedang must still enhance the planning and documentation components of standard procedures (Dwangu & Mahlangu, 2021; Paula Monteiro et al., 2022).

Regarding access of information to the public, students, and parents, SMKN 2 Bandung has a strong commitment to transparency and the participation of school residents in BLUD financial management. The degree of transparency at SMKN 1 Garut is likewise good, although socialization to all aspects of the school should still be improved to help everyone understand the financial system. In contrast to the other two schools, SMKN 1 Garut has a stricter control structure when it comes to financial oversight and evaluation. The continuous oversight and increased frequency of financial condition reports to the education office demonstrate this. SMKN 1 Sumedang still has to increase the frequency of financial status reports in order to be more in line with BLUD management standards (Ramadito, 2022; Zadeh Darjezi & Khansalar, 2013).

Overall, SMKN 1 Garut excels in BLUD financial planning and supervision, but SMKN 2 Bandung succeeds in information transparency and BLUD concept comprehension. The planning and transparency elements of SMKN 1 Sumedang still require improvement in order to better align with the principles of responsible and healthy financial management (Khoo et al., 2024; Office of the Auditor General, 2021). Enhancing socialization and fortifying internal control systems may be the primary approach to boosting BLUD financial management efficiency in any school (Hoai et al., 2022).

SMKN 1 Kuningan, SMKN 5 PANGALENGAN, and SMKN PERTANIAN PEMBANGUNAN LEMBANG have seen the most increases in student enrollment, with increases of 42%, 24%, and 21%, respectively. In the meantime, SMKN 1 TASIKMALAYA, SMKN 1 Banjar, and SMKN 11 Bandung experienced the biggest increases in teacher numbers, with increases of 38%, 23%, and 21%, respectively. On the other hand, the average respondent score for SMKN 1 TASIKMALAYA, SMKN 5 PANGALENGAN, SMKN 3 BANDUNG, SMKN 1 Cibinong, and SMKN 1 GARUT was 5 in the areas of organizational structure, teacher dedication, infrastructure, financial governance processes, and school community support.

However, SMKN 3 Bandung, SMKN 1 Tasikmalaya, SMKN 11 Bandung, SMKN Pertanian Pembangunan Lembang, and SMKN 5 Pangalengan have efficiency below 0.9 out of the vocational schools listed above (Table 4). SMKN 3 Bandung is actually the least effective DMU. This indicates that in addition to enhancing factors of financial health, the accessibility of financial data, and the

good intents of school communities, there is still potential to expand the number of certified teachers, industrial and corporate partners, and teaching factory conditions.

The findings of this study align with previous research on vocational school performance across different countries, reinforcing the critical role of financial governance, industry collaboration, and institutional management in determining efficiency levels. For instance, studies conducted in China (Li, 2024) and the Netherlands (Jenniskens et al., 2023) highlight how structured financial management and strong industry linkages contribute to the overall effectiveness of vocational schools. Similarly, research in Portugal (Sarrico & Rosa, 2009) and Thailand (Chalapati & Chalapati, 2020) emphasizes the significance of institutional governance and stakeholder engagement in shaping student outcomes. The results from the DEA analysis in this study reveal that while some BLUD SMKs demonstrate high efficiency, others still struggle with inefficiencies, which is consistent with findings in Morocco (Goumairi et al., 2020) and Estonia (Ploom & Haldma, 2013), where disparities in financial autonomy and administrative decision-making processes impacted school performance. The observed variations in teacher certification rates and financial transparency among BLUD SMKs also resonate with comparative studies in Indonesia and Malaysia (Purwanto et al., 2024), underscoring the need for policy improvements to ensure consistent educational quality across institutions.

Furthermore, this study reinforces findings from Brazil (Uemura & Comini, 2022) and Switzerland (Latina & Ramirez, 2017) that highlight the direct relationship between vocational school efficiency and the level of industry involvement, as seen in the case of SMKN 2 Bandung and SMKN 1 Garut, which have strong financial management structures and well-established industry partnerships. However, SMKN 3 Bandung and other underperforming schools face challenges similar to those reported in Turkey (Uzmanoğlu et al., 2010), where inefficiencies stemmed from limited access to financial resources, a lack of certified teachers, and weak collaboration with businesses. The need to enhance transparency, internal control mechanisms, and financial reporting—issues also observed in studies from Iceland and Slovenia (Ursula Renold et al., 2018)—suggests that addressing governance gaps is key to improving efficiency. These findings highlight the importance of implementing targeted policy interventions to strengthen financial management, enhance teacher certification programs, and foster sustainable school-business partnerships. By positioning this study within the broader academic discourse on vocational education effectiveness, it contributes to a deeper understanding of the institutional factors that drive efficiency in vocational schools.

## 6. Conclusion and Future Research

The purpose of this study is to evaluate BLUD SMK. The analysis's findings indicate that the majority of BLUD cannot be deemed effective. Therefore, it requires improved management oversight.

At the state SMK in West Java, an assessment of the Regional Public Service Agencies' (BLUD) governance reveals competency. To increase SMK's independence in managing finances and education, this governance is governed by the West Java Governor Regulation. Both financial and non-financial governance have shown efficiency, despite output-related obstacles. Supporting transparency and efficiency money management requires several aspects, including the financial stability of schools, the ease of access to financial information, and the positive involvement of the school community. Furthermore, BLUD's success is demonstrated by the improvement of its ties with industry and business partners.

Additionally, BLUD management at BLUD SMK supports to optimize teaching factories, which integrate the industrial environment with production-based learning. This effectiveness is mostly supported by managerial commitment, well-defined rules, and enhanced organizational capability, such as performance budgets and management information systems. Efficiency is demonstrated by



the best possible use of resources, which leads to more profitable learning that is pertinent to business demands. Good administration, simple access to financial records, and fostering willingness within the school community can all help to increase the efficiency of the teaching factory implementation. Thus, to guarantee transparent, effective, and long-lasting educational quality, BLUD management at SMKN must be consistently enhanced.

We believe it would be beneficial to enhance the performance evaluation of BLUD SMK from both theoretical and practical perspectives, taking consideration the limitations of our study. Principals of schools and national decision-makers can use more data to create pertinent policies and programs that improve the quality of education. The study's conclusions have important ramifications for school administrators as well, enabling them to allocate funds in the future in a more calculated and suitable manner. By examining resource efficiency and the results of status changes, those can identify successful initiatives that raise the possibility of generating more high-quality outputs.

In addition to involving more thorough data from more recent regions and years to come, further study is required to obtain a deeper understanding of BLUD SMK's performance utilizing other qualitative and quantitative approaches.

## Declarations

**Conflicts of Interest.** Authors declare no conflict of interest.

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