

An ArcGIS-Based Spatial Decision Support System Using Euclidean Distance and Multicriteria Analysis for Identifying the Optimal Candidate Locations for Low-Voltage Electrical Network Connections

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Abstract—Determining customer connection locations on a Low-Voltage Distribution Network is a critical stage in electricity distribution planning because it requires simultaneous consideration of spatial conditions and network technical capability. Manual evaluation processes are often time-consuming, depend heavily on the experience of field personnel, and may produce inconsistent recommendations. This study aims to develop a Spatial Decision Support System (SDSS) based on a Python Toolbox in ArcGIS Pro by integrating the Euclidean Distance method and multicriteria analysis to identify the most suitable candidate locations for customer connections on a Low-Voltage Distribution Network. This study employed a Research and Development (R&D) approach consisting of requirements analysis, system design, toolbox development, implementation, and testing. The Euclidean Distance method was applied to identify the five nearest distribution pole candidates from multiple distribution transformers as an initial screening stage. Each candidate was subsequently evaluated using multicriteria analysis based on transformer capacity, network reliability indices comprising the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI), transformer voltage conditions, and connection distance. The evaluated parameters were normalized, weighted according to their relative importance, and aggregated into a feasibility score to rank the candidate connection locations. The results demonstrate that the developed toolbox successfully automates candidate identification, technical evaluation, score calculation, and recommendation generation in a rapid, consistent, and objective manner. The integration of spatial analysis and multicriteria analysis within ArcGIS Pro improves evaluation efficiency compared with conventional manual procedures while providing technically reliable recommendations for selecting customer connection locations on Low-Voltage Distribution Networks.

Keywords—SDSS, ArcGIS Pro, Python Toolbox, Euclidean Distance, MCA

I. INTRODUCTION

In recent years, the industrial and commercial sectors in Indonesia have experienced significant growth. This is reflected in the industrial sector's electricity consumption, which accounts for approximately 49% of the country's total electricity consumption, making it the largest electricity-consuming sector among all sectors [1]. Furthermore, the number of industrial customers increased

substantially from 69,629 in 2016 to 300,248 in 2025, representing a growth of more than 300% during this period. Similarly, the commercial sector has also experienced considerable growth, with the number of customers increasing from 3,239,764 to 5,601,723, corresponding to an increase of approximately 73% over the same period [2].

The growth in customers across these sectors has led to an increasing number of electricity connection applications that must be processed by PT PLN (Persero). Unlike residential customers, industrial and commercial customers generally require more comprehensive technical evaluations due to their higher power demand, existing network conditions, and the capability of the distribution system to accommodate additional loads. Consequently, selecting an appropriate connection location has become a critical step in ensuring that the distribution network can provide safe, reliable, and standard-compliant electricity services.

In Low-Voltage Distribution Networks (LVDNs), selecting a connection point involves more than simply identifying the nearest distribution infrastructure. The process must also consider the technical condition of the distribution transformer that will supply the customer. Several technical parameters, including transformer capacity, network reliability, voltage quality, and connection distance, influence the feasibility of a connection location. In practice, multiple alternative connection points are often available within a relatively small area, requiring an evaluation mechanism capable of selecting the most appropriate candidate based on multiple criteria simultaneously [3],[4].

Currently, this evaluation process is still largely conducted manually through field surveys and technical assessments performed by utility personnel. Such an approach is time-consuming, highly dependent on individual experience, and may lead to inconsistent decisions for cases with similar characteristics. Furthermore, the growing number of connection requests has strengthened the need for a system capable of supporting the identification and evaluation of candidate connection locations in a faster, more objective, and more consistent manner [5],[6].

To address these challenges, location-based decision-support technologies have received increasing attention.

Recent advances in Geographic Information Systems (GIS) have enabled the integration of spatial and technical information to support more systematic decision-making processes. One widely adopted approach is the Spatial Decision Support System (SDSS), which integrates spatial data, attribute data, and analytical models to generate decision recommendations. In the electricity sector, SDSS has considerable potential to improve distribution network planning and evaluation by integrating spatial information with technical network parameters [7],[8].

In its implementation, SDSS employs various spatial analysis methods to identify feasible connection alternatives before more detailed technical evaluations are conducted. One of the most widely used methods for this initial identification stage is the Euclidean Distance method, which calculates the straight-line distance between a customer location and surrounding spatial objects. This method offers several advantages, including computational simplicity, speed, and efficiency, making it well suited for the initial screening of potential connection candidates. However, spatial proximity alone does not necessarily represent the technical feasibility of a connection point. The nearest candidate may not have sufficient transformer capacity, satisfactory network reliability, or acceptable voltage conditions. Therefore, a subsequent evaluation stage that simultaneously considers multiple technical parameters is required to produce more accurate location recommendations [9],[10].

Multicriteria Analysis (MCA) provides an effective framework for integrating multiple technical parameters into a single decision-making process. In this study, the evaluation criteria include transformer capacity, the System Average Interruption Duration Index (SAIDI), the System Average Interruption Frequency Index (SAIFI), distribution transformer voltage conditions, and connection distance. Through the weighting and aggregation of these parameters, MCA generates a feasibility score that can be used to rank candidate connection locations in a more objective and comprehensive manner than approaches based on a single evaluation criterion [8],[11].

Although the combination of spatial analysis and Multicriteria Analysis (MCA) offers a promising approach for connection location evaluation, its application to customer connection feasibility assessment in low-voltage distribution networks remains relatively limited. Most previous studies have focused on distribution network planning optimization, electrical infrastructure site selection, or isolated technical analyses of distribution systems. Consequently, the integration of spatial-based candidate identification with MCA-based technical evaluation within a unified decision-support framework has received limited attention [12,13]. However, the feasibility of a connection location is influenced not only by its proximity to the distribution network but also by transformer capacity, voltage profile, network reliability, and the required connection route. Therefore, a systematic approach capable of integrating all these parameters is required to generate more accurate location recommendations and support more comprehensive decision-making [4,8].

Based on these research gaps, this study develops a Spatial Decision Support System implemented as a Python Toolbox in ArcGIS Pro, integrating Euclidean Distance and Multicriteria Analysis (MCA) within a single automated workflow. The primary contribution of this research lies not only in integrating these two analytical methods but also in implementing them as an operational Python Toolbox that can be directly executed within the ArcGIS Pro environment. The developed system automates the entire evaluation process, including candidate connection identification, extraction of technical network parameters, feasibility score calculation, and recommendation ranking within a fully integrated workflow. Consequently, the proposed system provides a faster, more consistent, objective, and practical evaluation process than both conventional approaches and previous studies, which have generally focused on analytical models or separate evaluations of individual technical parameters.

II. RESEARCH METHOD

This study employed a Research and Development (R&D) approach to develop a Spatial Decision Support System (SDSS) based on a Python Toolbox within the ArcGIS Pro environment. The proposed system integrates spatial analysis using the Euclidean Distance method with Multicriteria Analysis to automatically identify and rank the most suitable candidate locations for customer connections in a low-voltage distribution network.

The research methodology consisted of several sequential stages, including system requirements analysis, spatial and attribute data preparation, Python Toolbox development, implementation of the candidate identification algorithm, multicriteria evaluation, and system validation. The developed toolbox automates the entire decision-making workflow, from identifying potential connection candidates based on spatial proximity to evaluating their technical feasibility using multiple criteria and generating ranked recommendations for the optimal connection location.

The study utilized both spatial and attribute data obtained from the distribution network information system of PT PLN (Persero) ULP Belanti. The spatial data consisted of customer locations and low-voltage distribution poles, while the attribute data included transformer capacity, the System Average Interruption Duration Index (SAIDI), the System Average Interruption Frequency Index (SAIFI), and distribution transformer voltage. Customer location data served as the starting point for the spatial analysis, whereas the distribution pole data were used to identify candidate connection locations. Transformer capacity was employed to evaluate the available loading capability of each candidate transformer. The SAIDI and SAIFI indices were incorporated as technical criteria to assess network reliability, while transformer voltage was used to evaluate power quality. These spatial and technical datasets were integrated within the proposed Spatial Decision Support System to support the identification, evaluation, and ranking of the most suitable customer connection locations.

The workflow is illustrated in the following figure.1



Fig. 1. ArcGIS Toolbox Workflow

The first stage begins with the input of the proposed customer's coordinates, which serve as the reference point for calculating the distance to the existing low-voltage distribution network. Based on this analysis, the system identifies the five nearest low-voltage distribution poles as candidate connection locations with euclidean distance method.

A. Euclidean Distance Method

Method employs the Euclidean Distance approach to calculate the straight-line distance between the customer location and all distribution poles within the selected low-voltage distribution network. This method serves as an initial spatial screening process to identify the nearest candidate connection points. The distance is calculated using the spatial coordinates of the customer location and each distribution pole based on the Euclidean distance equation [14],[15]:

$$d_i = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

where d represents the Euclidean distance between the customer location and a distribution pole, (x_1, y_1) denotes the coordinates of the customer location, and (x_2, y_2) denotes the coordinates of the distribution pole.

Based on the calculated distances, the system selects the five nearest distribution pole candidates. For low-voltage distribution poles (LV poles), the selected candidates are required to originate from different

distribution transformers to ensure that the generated alternatives are not concentrated within the same distribution network segment. This approach provides a more diverse set of candidate connection locations and supports a more comprehensive technical evaluation in the subsequent multicriteria analysis.

B. Multicriteria Analysis

After the candidate distribution poles have been identified, each candidate is evaluated using multiple technical criteria to determine its overall suitability for customer connection. To enable meaningful comparison among criteria with different units and scales, each technical parameter is first converted into a standardized score ranging from 1 to 10 based on predefined evaluation thresholds. The standardized scores are subsequently combined using a weighted scoring method, in which each criterion is assigned a weight according to its relative importance. The weighted scores are then aggregated to produce a single Technical Score, representing the overall technical feasibility of each candidate connection location.

1. System Average Interruption Duration Index (SAIDI)

The System Average Interruption Duration Index (SAIDI) is used as one of the reliability criteria in the multicriteria evaluation process [16],[17]. To ensure consistency with the other evaluation criteria, SAIDI values are transformed into a standardized score ranging from 1 to 10, where a score of 10 represents the most favorable network reliability condition and a score of 1 represents the least favorable condition [18]. Intermediate scores between 2 and 9 are calculated using linear interpolation between the predefined best and worst threshold values [18]. In this study, a SAIDI value below 5 minutes per customer per year is considered the best performance and is assigned the maximum score of 10. This threshold is consistent with the utility's Key Performance Indicator (KPI), in which outage durations of less than five minutes are excluded from performance calculations [19]. Conversely, a SAIDI value exceeding 120 minutes per customer per year (equivalent to two hours) is considered the worst performance and is assigned the minimum score of 1, in accordance with the utility's Service Quality Standards (TMP) [19]. SAIDI values falling between these two thresholds are converted into standardized scores through linear interpolation using the following equation:

$$SCORE_{SAIDI} = \begin{cases} 10, & X_{SAIDI} \leq 5 \\ 1, & X_{SAIDI} \geq 120 \\ 10 - 9 \times \frac{X_{SAIDI} - 5}{120 - 5}, & 5 < X_{SAIDI} < 120 \end{cases}$$

2. System Average Interruption Frequency Index (SAIFI)

The System Average Interruption Frequency Index (SAIFI) is employed as a network reliability criterion to measure the average number of power interruptions experienced by customers within one year [16],[17]. Similar to the SAIDI criterion, SAIFI values are transformed into a standardized score ranging from 1 to 10, where a score of 10 represents the best reliability performance and a score of 1 represents the poorest reliability performance [18]. Intermediate scores between 2 and 9 are determined using linear interpolation between the predefined best and worst threshold values [18]. In this study, a SAIFI value of 0 interruptions per customer per

year is considered the optimal condition and is assigned the maximum score of 10, reflecting a distribution network that experiences no service interruptions. Conversely, a SAIFI value of 5 interruptions per customer per year or greater is assigned the minimum score of 1, as this level indicates relatively frequent power outages experienced by customers supplied from the same distribution transformer or feeder [19]. SAIFI values between these thresholds are converted into standardized scores using linear interpolation according to the following equation:

$$SCORE_{SAIFI} = \begin{cases} 10, X_{SAIFI} \leq 0 \\ 1, X_{SAIFI} \geq 5 \\ 10 - 9 \times \frac{X_{SAIFI} - 5}{120 - 5}, 0 < X_{SAIFI} < 5 \end{cases}$$

for 0 until 5:

$$SCORE_{SAIFI} = 10 - 9 \left(\frac{X_{SAIFI}}{5} \right)$$

3. Distribution Transformer Reserve Capacity Score

Transformer capacity is evaluated based on the reserve margin after deducting the customer's power demand [18],[20]. The greater the remaining reserve capacity, the better the transformer's ability to accommodate additional loads, resulting in a higher score [20]. A reserve margin of 30% is considered the best value, based on the PT PLN Board of Directors Regulation, which specifies that the ideal transformer loading ranges from 40% to 80%, where 80% is regarded as the optimal loading level [19],[20]. Therefore, an ideal reserve margin of 30% is adopted (10% below the maximum loading level). Conversely, the worst reserve margin is defined as a remaining reserve capacity of less than 6% [19].

$$R = \frac{K_{remaining}}{K_{available}}$$

The transformer reserve margin (R) is calculated by dividing the remaining transformer capacity after deducting the customer's power demand $K_{remaining}$ by the available transformer capacity before the customer connection $K_{available}$. Both capacity values are expressed in kilovolt-amperes (kVA).

$$S_{kap} = \begin{cases} 10, R \geq 10 \\ 9, 27\% \leq R < 30\% \\ 8, 24\% \leq R < 27\% \\ 7, 21\% \leq R < 24\% \\ 6, 18\% \leq R < 21\% \\ 5, 15\% \leq R < 18\% \\ 4, 12\% \leq R < 15\% \\ 3, 9\% \leq R < 12\% \\ 2, 6\% \leq R < 9\% \\ 1, R < 6\% \end{cases}$$

4. Distribution Transformer Voltage Score

The distribution transformer voltage is evaluated by converting the measured voltage into a standardized score ranging from 1 to 10, where a score of 10 represents the most favorable condition and a score of 1 represents the least favorable condition [18],[21]. Intermediate scores (2–9) are determined using linear interpolation between the predefined best and worst threshold values [18]. A transformer voltage greater than 198 V is assigned the maximum score of 10, as this value is consistent with the minimum operating voltage standard for distribution transformers [21],[22]. Conversely, a transformer voltage equal to or less than 170 V is assigned the minimum score

of 1, indicating an excessive voltage drop. Voltage values between these thresholds are converted into standardized scores using linear interpolation according to the following equation:

$$SCORE_{VTR} = \begin{cases} 10, V_{TR} \geq 198 \\ 1, V_{TR} \leq 170 \\ 1 + 9 \frac{V_{TR} - 170}{198 - 170}, 170 < V_{TR} < 198 \end{cases}$$

for 170 until 198V:

$$SCORE_{VTR} = 1 + 9 \frac{V_{TR} - 170}{28}$$

5. Technical Score for the Low-Voltage Distribution Network (LV)

For customers served by the low-voltage (LV) distribution network, the technical score is calculated based on four parameters: SAIDI, SAIFI, transformer reserve capacity, and transformer voltage. Each parameter is assigned an equal weight according to its importance in evaluating the feasibility of the proposed customer connection.

The technical score for the low-voltage distribution network is calculated as follows:

$$ST_{TR} = 0.25S_{SAIDI} + 0.25S_{SAIFI} + 0.25S_{KAP} + 0.25S_{TEG}$$

STTR : technical score of the low-voltage distribution network

SSAIDI : SAIDI score

SSAIFI : SAIFI score

SKAP : transformer reserve capacity score

STEG : transformer voltage score

Since all evaluation criteria are assigned equal importance, the total weighting factor is:

$$0.25 + 0.25 + 0.25 + 0.25 = 1$$

6. Technical Score for the Low-Voltage Distribution Network (LV)

Once the Technical Score has been determined, the system calculates the Final Score based on two main components:

$$SA = 0.80(ST) + 0.20(SD)$$

where:

SA = final score

ST = technical score

SD = distance score

The Technical Score is assigned a higher weight to ensure that the recommended connection location maintains network reliability, electricity supply quality, and the capacity of the existing distribution network in accordance with PT PLN (Persero) technical standards.

C. Feasibility Classification and Recommendation Ranking

The final stage generates the connection location recommendations. All candidate locations are ranked from the highest to the lowest Final Score and classified into feasibility categories, namely Highly Feasible, Feasible, Moderately Feasible, Less Feasible, and Not Feasible, based on predefined score ranges.

The system outputs a ranked list of recommended connection locations, including the distribution pole identification, analysis method, technical parameters, individual parameter scores, Final Score, feasibility category, and recommendation priority. This information supports users in selecting the most appropriate customer connection location according to the existing distribution network conditions.

III. RESULT AND DISCUSSION

A. Development of the Spatial Decision Support System

The main objective of this study was to develop a Python Toolbox (.pyt) within the ArcGIS Pro environment as the implementation platform for the proposed Spatial Decision Support System (SDSS). The toolbox, named Location Feasibility Score Calculator, was designed to automate the evaluation of candidate electrical connection locations by integrating spatial analysis and multicriteria evaluation into a single geoprocessing tool [23],[24]. The toolbox is integrated into the Geoprocessing pane of ArcGIS Pro, allowing users to execute the analysis in the same manner as the built-in geoprocessing tools [23]. Through this implementation, users can perform the complete analysis—from customer location input to the generation of ranked connection location recommendations—within a single automated workflow.

The developed toolbox, named Location Feasibility Score Calculator, was implemented using Python (ArcPy) on the ArcGIS Pro 3.5.3 platform [24]. The toolbox consists of five functional modules that integrate the entire analysis workflow. It employs the Euclidean Distance and Weighted Scoring methods to evaluate candidate connection locations. The system generates outputs in the form of location scores, location rankings, and feasibility categories, providing decision support for selecting the most suitable connection location.

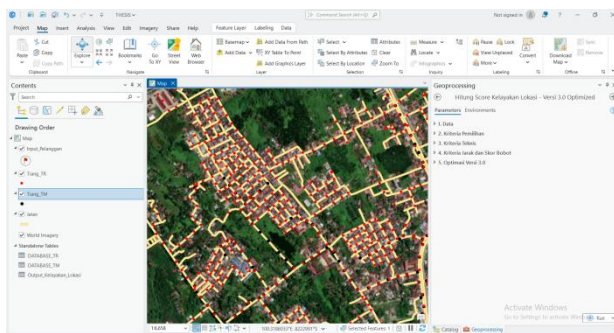


Fig. 2. Python Toolbox "Location Feasibility Score Calculator" in ArcGIS Pro

TABLE I. TECHNICAL SPECIFICATIONS OF THE DEVELOPED ARCGIS PYTHON TOOLBOX

Component	Description
Toolbox Name	Location Feasibility Score Calculator
Programming Language	Python (ArcPy)

Platform	ArcGIS Pro 3.5.3
Number of Modules	5 modules
Analysis Methods	Euclidean Distance, Multicriteria Analysis
Outputs	Location Feasibility Score Table, Location Ranking, and Feasibility Category

B. Candidate Identification Using Euclidean Distance

The first stage of the proposed system identifies candidate connection locations using the Euclidean Distance method. This method calculates the straight-line distance between the customer location and all low-voltage distribution poles within the service area of the distribution transformer [14],[15]. The identified poles are then ranked according to their distances, and the five nearest candidates are selected for further evaluation. In this study, the Euclidean Distance method is used as a candidate screening approach rather than for determining the optimal connection location directly [18],[25]. By reducing the number of candidate locations before the multicriteria evaluation, the computational process becomes more efficient while minimizing subjectivity during the initial selection stage [18]. The testing results demonstrate that the proposed method consistently identifies suitable candidate connection locations for all tested customer locations, providing an effective basis for the subsequent multicriteria analysis.

C. Candidate Evaluation Using Multicriteria Analysis

After the candidate locations are identified, the system evaluates each candidate using Multicriteria Analysis (MCA). This approach is employed because the nearest connection location is not always the most suitable option when the technical conditions of the distribution network are considered. Each candidate is evaluated based on five criteria: connection distance, transformer reserve capacity, SAIDI, SAIFI, and transformer voltage. The criteria are assigned weights according to their relative importance, and the weighted scores are aggregated to obtain the final feasibility score for each candidate. The evaluation integrates both spatial and technical considerations, ensuring that the recommended connection location is selected based not only on proximity but also on the capability and reliability of the distribution network [18],[25]. The results show that, in several cases, the nearest candidate did not achieve the highest final score due to limited transformer capacity or lower network reliability, demonstrating that the proposed multicriteria approach provides a more comprehensive decision-making process than a distance-based method alone.

D. Toolbox Implementation and System Performance Analysis

After the development phase, the proposed toolbox was tested to verify that all functions operated as intended. The evaluation was conducted using the distribution network data of PT PLN (Persero) ULP Belanti, including customer locations, road networks, low-voltage (LV) poles, and medium-voltage (MV) poles. All analyses were performed using the developed Location Feasibility Score Calculator toolbox.

The testing aimed to evaluate the toolbox's capability to automatically integrate data processing, candidate identification, technical parameter evaluation, score calculation, and connection location recommendation. A case study was conducted using a single proposed customer connection with a low-voltage (LV) power demand (table 2). The proposed connection location is surrounded by several nearby distribution poles, where the red points represent the available LV poles, as illustrated in Figure 3.

After executing the toolbox, the location feasibility results are automatically generated and presented in the output table, as shown in table 2.

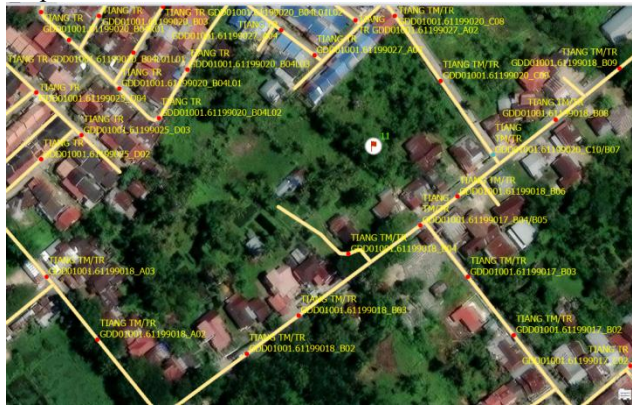


Fig. 3. Proposed Electrical Network Connection Location

TABLE II. LOCATION CONNECTION FEASIBILITY ASSESSMENT RESULTS

JENIS JAR	METODE	RANK	ID TIANG	KELOMPOK	JARAK_M
TR	LURUS	1	TIANG TM/TR GDD01001.61199017_B04/B05	GDD01001.61199017	54.7353216
TR	LURUS	2	TIANG TM/TR GDD01001.61199020_C09	GDD01001.61199020	55.6753651
TR	LURUS	3	TIANG TM/TR GDD01001.61199018_B06	GDD01001.61199018	58.2761927
TR	LURUS	4	TIANG TR GDD01001.61199027_A03	GDD01001.61199027	64.2780173
TR	LURUS	5	TIANG TR GDD01001.61199025_D03	GDD01001.61199025	173.969174

JENIS JAR	METODE	RANK	ID TIANG	KAP, BUTIR, SISA, TEGAN									
				KVA	JUA	KVA	SAU	SC	SAHU	SC	KAP	SC	TES
TR	LURUS	1	TIANG TM/TR GDD01001.61199017_B04/B05	43	34.74	8.26	220	10	10	10	6.76	10	9.19
TR	LURUS	2	TIANG TM/TR GDD01001.61199020_C09	50	34.74	15.26	220	10	10	10	10	10	9.35
TR	LURUS	3	TIANG TM/TR GDD01001.61199018_B06	30	34.74	4.74	220	10	10	10	7.75	10	8.2
TR	LURUS	4	TIANG TR GDD01001.61199027_A03	133	34.74	97.81	220	10	8.2	10	9.55	10	9.64
TR	LURUS	5	TIANG TR GDD01001.61199025_D03	75	34.74	40.26	220	10	10	10	10	10	9.85

As shown in table 2, the testing results identified five nearest distribution poles supplied by different distribution transformers from the proposed customer location. for each candidate, the toolbox generated the connection distance, distance score, technical score, final score, and feasibility category. the output table also presents the ranking of the candidates from rank 1 to rank 5 in descending order of the final score. based on the evaluation results, the recommended connection point is distribution pole ID Tiang TM/TR GDD01001.61199017_B04/B05, which achieved the highest final score.

to verify the accuracy of the developed toolbox, the distance between the selected distribution pole and the proposed customer location was measured manually in arcgis pro using the measure distance tool. the measurement result was 54.74 meters, which is identical to the distance calculated by the developed toolbox,

confirming the accuracy of the spatial analysis. the verification result is illustrated in figure 4.

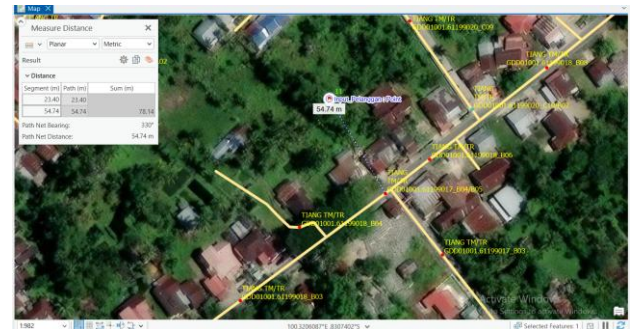


Fig. 4. Manual Verification of Distance Measurements in ArcGIS Pro

Compared with the conventional manual procedure, the developed toolbox significantly improves the efficiency and consistency of the connection location assessment process. Instead of manually measuring distances, collecting technical data, and evaluating each candidate individually, the system automatically identifies the five nearest candidate poles, extracts the required technical parameters, calculates the Distance Score, Technical Score, and Final Score, and generates ranked recommendations within a single workflow. This automation reduces processing time, minimizes subjective judgment, and ensures consistent evaluation by applying identical criteria and weighting to all candidates. The output includes the distribution pole ID, technical parameters, individual parameter scores, Final Score, feasibility category, and recommendation priority, enabling users to make faster and more objective decisions. Manual verification using the ArcGIS Pro Measure Distance tool confirmed that the calculated distance was identical to the toolbox output, demonstrating the accuracy and reliability of the proposed spatial analysis method.

IV. CONCLUSION

The proposed ArcGIS-based Spatial Decision Support System (SDSS) was successfully developed as a Python Toolbox in ArcGIS Pro to automate the feasibility assessment of electrical connection locations. The toolbox integrates the entire workflow, including data input, candidate pole identification, spatial analysis, technical evaluation, weighted scoring, and recommendation generation within a single geoprocessing tool.

The developed system successfully implements the Euclidean Distance method for candidate identification and applies a multicriteria analysis based on transformer reserve capacity, SAIDI, SAIFI, transformer voltage, feeder voltage, and connection distance. A weighting scheme of 80% for technical criteria and 20% for distance was adopted to calculate the final feasibility score and objectively rank the candidate connection locations.

Overall, the developed toolbox achieved the objectives of this study by providing an effective Spatial Decision Support System that supports faster, more objective, consistent, and efficient decision-making for selecting electrical connection locations for industrial and

commercial customers compared with conventional manual assessment procedures.

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