

## Evaluating Technopark Service Quality Using The Carter Model And Importance-Performance Analysis (IPA) (Comparative Study Of Solo, Bandung, And Pekalongan Technoparks)

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### Abstract

Technoparks play a pivotal role in fostering regional innovation; however, many in Indonesia face significant challenges, including underutilized facilities and inconsistent service quality, which constrain their overall effectiveness. This study aims to evaluate and enhance the service quality of Technoparks in Java—specifically in Solo, Bandung, and Pekalongan—by implementing the CARTER model, which assesses six dimensions: Compliance, Assurance, Reliability, Tangibles, Empathy, and Responsiveness. A quantitative approach was employed, integrating the Customer Satisfaction Index (CSI) and Importance-Performance Analysis (IPA), further enriched by spatial mapping. Using non-probability sampling due to an unknown population, the sample size of 128 visitors (64 for importance and 64 for satisfaction) was determined via GPower power analysis (effect size=0.5,  $\alpha=0.05$ , power=0.80). The findings reveal varying levels of visitor satisfaction across the locations. Pekalongan Technopark achieved the highest CSI score of 87.41% ("Excellent"), followed by Bandung Technopark at 83.77% ("Good") and Solo Technopark at 82.05% ("Good"). The IPA results highlight that the Empathy and Responsiveness dimensions require significant improvement, particularly at Solo Technopark. Consequently, this study recommends strategic interventions focused on service development tailored to visitor needs, the optimization of underutilized facilities, and the enhancement of human resource quality. These findings serve as a strategic reference for Technopark management to bolster competitiveness and contribute to the sustainable development of local innovation and economic ecosystems.

**Keywords:** CARTER Model, Customer Satisfaction Index (CSI), Importance-Performance Analysis (IPA), Service Quality, Technopark.

### INTRODUCTION

A Technopark is an integrated science and technology hub designed to harmonize scientific development, industry demands, and regional competitiveness, ultimately fostering local economic growth (Nam et al., 2015; Seo & Ro, 2022). Its success relies heavily on optimal facility utilization and effective stakeholder collaboration. Despite high visitor numbers, several facilities remain underutilized, leading to an imbalance in visitor distribution within the technopark (Mondal et al., 2023). For instance, Solo Technopark (STP), which focuses on innovation and vocational development, experiences severe congestion in certain areas, while facilities like the Game Working Space and Cyber Security areas remain empty. This uneven utilization results in operational inefficiencies—such as the frequent deactivation of escalators—diminishing the overall visitor experience. Similarly, preliminary surveys at Bandung Techno Park (BTP), a hub centered on university-level innovation, identified critical issues including slow responsiveness to tenant needs, limited training support, and the absence of a structured feedback system. Meanwhile, Pekalongan Technopark (PTP), strategically developed for the fisheries sector, has yet to reach the broader public due to suboptimal functionality. As emphasized during a joint workshop, PTP's focus remains primarily on basic infrastructure with low public participation. To

address these operational inefficiencies, continuous quality improvement is imperative. Measuring visitor satisfaction is an effective strategy to understand customer expectations and prioritize service enhancements (Mihelis et al., 2001). Among various methodologies, the Customer Satisfaction Index (CSI) is highly effective for monitoring trends and guiding corrective actions (Hajduk et al., 2022).

Numerous studies have extensively utilized the Customer Satisfaction Index (CSI) and Importance-Performance Analysis (IPA) to evaluate service quality and prioritize improvements across various sectors. In doing so, this research extends the theoretical boundary of the CARTER model by situating it within the context of public technology parks, contributing to the broader discourse on service quality measurement in non-financial innovation-driven institutions. However, because Technoparks function uniquely as hubs for education and innovation, conventional evaluation models must be adapted. This study offers novelty through a comprehensive approach that modifies the traditional framework by incorporating the Compliance dimension (Ali & Raza, 2015). Consequently, this research not only assesses visitor satisfaction but also analyzes adherence to service standards using the CARTER model. As an extension of the SERVQUAL framework, CARTER encompasses Compliance, Assurance, Reliability, Tangibles, Empathy, and Responsiveness (Chimbo et al., 2023; Wright et al., 2021), making it highly relevant for capturing the distinct identity and operational standards of a Technopark.

This study integrates spatial analysis to discern visitor movement patterns and identify areas with low footfall. By synthesizing customer satisfaction analysis with spatial mapping, this research generates data-driven recommendations to enhance the accessibility and appeal of underutilized facilities (Kartikasari et al., 2019). To prioritize improvements, Importance-Performance Analysis (IPA) will be employed to evaluate the relative importance and performance of various attributes, providing strategic guidance for innovation and quality enhancement. IPA is widely recognized for its simplicity and flexibility, making it an ideal framework for establishing priorities within the constraints of limited resources. The combined application of CSI (Customer Satisfaction Index), IPA, and spatial analysis offers deeper insights for formulating strategies to upgrade Technopark facilities and services. This research aims to conduct a comparative analysis of service quality across different regional Technoparks, specifically STP, BTP, and PTP. The findings are expected to provide constructive input for optimizing performance and services, while simultaneously supporting sustainable local economic development.

## RESEARCH METHOD

This methodological approach is appropriate for a systematic analysis of visitor perceptions and the formulation of strategic recommendations derived from empirical quantitative data. The literature review focuses on core theoretical frameworks, including Service Quality, Customer Satisfaction, the CARTER model (Compliance, Assurance, Reliability, Tangibles, Empathy, and Responsiveness), the Customer Satisfaction Index (CSI), and Importance-Performance Analysis (IPA). Preliminary field observations provided the initial context, which facilitated the formulation of specific research problems. These findings subsequently guided the development of the primary research instrument: a structured questionnaire.

This study employs a non-probability sampling technique, as the precise size of the visitor population remains indeterminate (Setia, 2016). The minimum sample size was determined using G\*Power software. Specifically, the calculation was based on a statistical test for "Means: Difference between two independent means (two groups)," conducted via an a priori power analysis to ascertain the necessary sample size (Mishra et al., 2019). Input parameters were selected based on theoretical considerations and established conventions in social science research. These parameters include a medium effect size ( $d$ ) of 0.50, an alpha ( $\alpha$ ) error probability of 0.05, a statistical power ( $1-\beta$ ) of 0.80, and an allocation ratio ( $N_2/N_1$ ) of 1. The selection of a 0.50 effect size is sufficiently sensitive to detect meaningful differences in visitor satisfaction studies. The alpha level of 0.05 serves as the standard significance threshold, representing a 5% tolerance for Type I errors. Furthermore, a power of 0.80 ensures an 80% probability of detecting a true effect, thereby minimizing the risk of Type II errors. Finally, an allocation ratio of 1 was adopted to maintain a balanced sample distribution between groups, ensuring optimal analytical efficiency.

Furthermore, reliability testing was conducted to assess the internal consistency of the instrument, ensuring the generation of stable and consistent data (Spiliotopoulou, 2009). Reliability was evaluated using

Equation 1.2, based on the Cronbach’s Alpha coefficient. A construct is deemed reliable if its Cronbach’s Alpha value exceeds the widely accepted threshold of 0.60, which signifies an acceptable level of reliability for social science research. This assessment was performed on data derived from a pilot study. Consequently, only items proven to be both valid and reliable were retained for the final iteration of the questionnaire utilized during the primary data collection phase.

Data were collected from the research population, comprising all visitors to Technoparks in Java, by distributing questionnaires to a representative sample of this population. A hybrid approach was employed for distribution, integrating direct on-site dissemination with online distribution via Google Forms to ensure extensive reach. The collected data, which capture visitor perceptions regarding the importance and performance of various service attributes using a Likert scale, were subsequently subjected to two primary quantitative analysis techniques (Wu & Leung, 2017). First, the Customer Satisfaction Index (CSI) was calculated to determine the overall level of visitor satisfaction (Shin, 2014).

$$CSI = \left[ \frac{\sum_{i=1}^P WSi}{HS} \right] \times 100\% \quad \dots\dots\dots (1.1)$$

- $\sum_{i=1}^P WSi$  = The aggregate mean importance from attribute i to p
- HS = The maximum scale value or the highest possible score

Second, Importance-Performance Analysis (IPA) is utilized to map service attributes onto a four-quadrant matrix, thereby facilitating the identification of primary areas for strategic improvement (Feng et al., 2014; Piñeiro et al., 2006). Quadrant I: "Concentrate Here", this quadrant identifies attributes categorized as highly significant to customers, yet the organization’s performance in these areas remains suboptimal. Consequently, these deficiencies serve as the primary drivers of customer dissatisfaction. Quadrant II: "Keep Up the Good Work" Characterized by "high importance and high performance," this quadrant highlights specific product or service attributes that are highly valued by customers and for which the organization has successfully met or exceeded expectations. As a result, the organization must sustain—and further optimize—its performance in these areas to ensure continuous and maximal customer satisfaction.

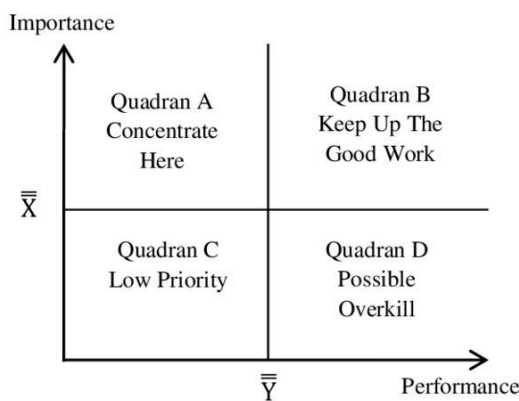


Figure 1. Cartesius Diagram  
 Source: Adapted from Lambert et al. (2018)

Quadrant III: Low Priority. This means the quadrant is rated as low importance and low performance, signifying that some attributes are less influential to customers. Quadrant IV: Possible Overkill. This means that attributes or variables in the "low importance, high performance" quadrant are things the company is already doing well, but they are not highly regarded by customers. Therefore, the company can reallocate resources and focus on matters that are more important to consumers.

## RESULT AND DISCUSSION

In this study, each technopark has different specific indicators. Adapting the CARTER dimensions to these locations allows for a more accurate assessment of visitor expectations and performance perceptions, as each Technopark operates under different local innovation ecosystems and resource availability. At Solo Technopark, a total of 23 statement items were used as indicators to measure the variables under investigation, as listed in Table 1. Each technopark uses a distinct set of indicators tailored to its local context and sectoral orientation—23 items for Solo, 25 for Bandung, and 25 for Pekalongan—all developed based on the CARTER model framework and adapted from previous research (Dyah Zahra Wati et al., 2023). Validity and reliability tests confirmed that all instruments met the required thresholds ( $r$ -value >  $r$ -table; Cronbach's Alpha > 0.6), affirming their suitability for use in the primary data collection phase. The complete details of each statement indicator used in this study can be seen in the following table, which contains a description of the items according to each variable dimension.

Table 1. Indicator in Solo Technopark

SOLO Technopark		
Dimensions	Attribute	Indicator
<i>Compliance</i>	C1	Strategic location close to economic activity centers and higher education institutions, with easy access via public transportation.
	C2	Availability of various workspace options equipped with modern technology that supports productivity.
	C3	The available facilities use state-of-the-art technology, including a high-speed internet network, advanced IT devices, and a reliable security system.
	C4	The organization of various interesting activities, such as seminars, exhibitions, and other programs that support community development.
	C5	The available facilities encourage collaboration between various parties, such as startups, large companies, academics, and the general public.
	C6	A diverse selection of food and beverages in the food hall with budget-friendly prices.
<i>Assurance</i>	A1	Availability of responsive and alert security personnel to maintain environmental security.
	A2	A spacious and secure parking area for visitors.
	A3	The operational hours of Solo Technopark are consistently implemented according to the predetermined schedule.
	A4	Visitors feel a comfortable and safe atmosphere while within the Solo Technopark environment.
<i>Reliability</i>	R1	The facilities at Solo Technopark are attractive, well-maintained, and create a comfortable atmosphere for visitors.
	R2	Access to various technological devices and supporting facilities at Solo Technopark is easily reachable.
	R3	Staff provide fair service to all visitors without discriminating based on appearance or social background.
<i>Tangible</i>	T1	The facilities at Solo Technopark are attractive, well-maintained, and create a comfortable atmosphere for visitors.
	T2	Access to various technological devices and supporting facilities at Solo Technopark is easily reachable.
	T3	Supporting facilities such as toilets and prayer rooms are clean, comfortable, and proper for use.
	T4	Staff show a friendly, polite, and professional attitude in providing service.
<i>Emphaty</i>	E1	Staff are always willing to receive and respond to visitor complaints with a good response.
	E2	Staff are ready to provide assistance to visitors who face obstacles or difficulties.

	E3	Staff have high initiative in providing service without having to be asked first.
	E4	The service provided by staff creates a sense of comfort and satisfaction for visitors.
<i>Responsiveness</i>	Rs1	Communication channels are available for visitors to convey criticism and suggestions.
	Rs2	Requests or questions from visitors are handled by staff quickly and responsively.

The validity test, calculated using SPSS software for all attributes, showed that the calculated r-value was greater than the r-table value for every item. Therefore, the entire instrument is considered valid and can be used. The reliability test yielded a result of 0.940 for the importance questionnaire (with a total of 23 attributes) and 0.946 for the satisfaction questionnaire (also with 23 attributes). Since the value for each questionnaire is > 0.6, they can be declared reliable for measurement and further research.

In the research conducted at Bandung Technopark, represented in Table 2, a total of 25 statement items were used as indicators to measure the variables under investigation. For the Bandung Technopark indicators, the validity test was calculated using SPSS software on all attributes. The results showed that the calculated r-value was greater than the r-table value for every item; therefore, the entire instrument can be declared valid and is ready for use. Meanwhile, the reliability test yielded a result of 0.940 for the importance questionnaire (with a total of 25 attributes) and 0.963 for the satisfaction questionnaire (also with 25 attributes). Since the value for each questionnaire is > 0.6, they are considered reliable for measurement and further research.

Table 2. Indicator in Bandung Technopark

Bandung Technopark		
Dimensions	Attribute	Indicator
<i>Compliance</i>	C1	Establishing collaboration and forming networks in accordance with applicable regulations.
	C2	Providing workspaces that support productivity as part of operational compliance.
	C3	Modern facilities are standardized and equipped with the latest information technology.
	C4	Organizing programs and events to support the implementation of rules and to form a compliant work culture.
	C5	The availability of facilities for collaboration between startups, companies, academics, and the community within the framework of innovation and compliance.
	C6	Providing business training, financing support, and partnership offers for business development.
<i>Assurance</i>	A1	Security is maintained by alert and professional personnel.
	A2	The parking area is sufficiently available and safe to use.
	A3	BTP is consistent in implementing its operational hours according to the schedule.
	A4	Visitors feel safe and comfortable in the Bandung Technopark environment.
	A5	Staff provide accurate information regarding the available facilities and services.
<i>Reliability</i>	R1	The location and service facilities of BTP are considered proper and adequate to support visitor activities.
	R2	Information regarding Bandung Technopark is trustworthy and delivered accurately.
	R3	Service is provided without discrimination, regardless of the visitor's status or appearance.
<i>Tangible</i>	T1	Facilities at Bandung Technopark are modern, attractive, well-maintained, and comfortable for visitors.
	T2	Users have easy access to the various facilities and technological devices available at BTP.
	T3	Supporting facilities such as toilets and prayer rooms are provided in a clean and usable condition.
	T4	Staff serve with a polite and friendly attitude.
	T5	The BTP environment provides aesthetic value and strong visual appeal for visitors.

<i>Empathy</i>	E1	Staff are always ready to respond well to complaints or feedback from visitors.
	E2	Staff are willing to help if visitors experience any problems.
	E3	Staff show initiative in providing services proactively.
	E4	The service provided creates comfort for the visitors.
<i>Responsiveness</i>	Rs1	Special media or channels are available for conveying suggestions and complaints.
	Rs2	Staff provide a quick response to questions or requests for information from visitors.

In the research conducted at Pekalongan Technopark, represented in Table 3, a total of 25 statement items were used as indicators to measure the variables under investigation. For the Pekalongan Technopark indicators, the validity test was calculated using SPSS software on all attributes. The results showed that the calculated r-value was greater than the r-table value for every item; therefore, the entire instrument can be declared valid and is ready for use. Meanwhile, the reliability test yielded a result of 0.944 for the importance questionnaire (with a total of 25 attributes) and 0.954 for the satisfaction questionnaire (also with 25 attributes). Since the value for each questionnaire is > 0.6, they are considered reliable for measurement and further research.

Table 3. Indicator in Pekalongan Technopark  
Pekalongan Technopark

Dimensions	Attribute	Indicator
<i>Compliance</i>	C1	The Technopark follows government policies and national standards in providing services.
	C2	Provides facilities and technical guidance to support MSME innovation.
	C3	Ensures cooperation with various parties in accordance with laws and regulations.
	C4	Carries out activities according to established technical guidelines.
	C5	Establishes cross-sectoral collaboration in accordance with applicable rules.
<i>Assurance</i>	A1	The physical environment is safe and comfortable.
	A2	Security and technical personnel are competent and ready to add experts if needed.
	A3	Staff are communicative and responsive in providing information to visitors.
	A4	Visitors trust the implemented security and service systems.
<i>Reliability</i>	R1	Facilities are available in optimal condition for user activities.
	R2	Training is provided by experienced mentors to help MSMEs and fishermen.
	R3	Service information is delivered accurately and is up-to-date.
	R4	Services are carried out on time, reflecting a disciplined and professional work system.
<i>Tangible</i>	T1	Facilities are kept clean, tidy, and comfortable for visitors.
	T2	Access to the area is easy with clear location directions.
	T3	The ergonomic layout supports learning and work activities.
	T4	Supporting facilities are complete and ready to use.
<i>Empathy</i>	E1	Staff are patient and respectful of visitors' questions and needs.
	E2	Staff understand specific needs and strive to provide the best solutions.
	E3	Staff are caring and responsive, including towards visitors with disabilities.
<i>Responsiveness</i>	E4	Visitors feel attended to and are quickly assisted when experiencing problems.
	Rs1	Pekalongan Technopark staff are easy to contact and always available to provide assistance when needed.
	Rs2	Channels are available for criticism, suggestions, and requests for assistance.
	Rs3	Visitor requests are responded to quickly and according to their needs.
	Rs4	Visitor feedback is followed up on for service improvement.

Table 4 shows respondent data. This respondent data aims to describe the characteristics of visitors at three Technoparks in Indonesia: Solo Technopark (STP), Bandung Technopark (BTP), and Pekalongan Technopark (PTP). The respondent data is focused on gender, age, occupation, domicile, frequency of visits, purpose of visit, and the source of information about the technopark. The results of the respondent data can be seen in the table below.

Table 4. Respondent Data

Respondent Data	Characteristic	STP	BTP	PTP	Total
Gender	Male	45%	31%	59%	42%
	Female	55%	69%	41%	58%
Age	<18 Years	2%	22%	1%	22%
	18-25 Years	17%	47%	25%	27%
	25-30 Years	74%	20%	22%	31%
	>30 Years	7%	11%	52%	20%
Occupation	Fisherman	0	0	45%	11%
	Entrepreneur	7%	5%	20%	9%
	Student	61%	63%	10%	52%
	Civil Servant	6%	4%	11%	7%
	Employee	10%	17%	3%	9%
	Others	16%	11%	11%	13%
Domicile / City of Residence	Around the technopark	63%	51%	52%	62%
	Outside the technopark's city	37%	49%	48%	39%
Frequency of Visits	1 time	41%	45%	11%	27%
	>2 times	59%	55%	89%	74%
Purpose of Visit	Working	4%	6%	62%	19%
	Training	5%	0	12%	4%
	Education	45%	37%	13%	37%
	Business	5%	11%	5%	6%
	Others	50%	52%	15%	41%
Technopark Information	Social media	48%	36%	16%	26%
	Official website	8%	9%	5%	10%
	Recommendation from friends/family	39%	39%	31%	46%
	Others	5%	16%	48%	19%

Table 5 is the Result of CSI Three Technopark. The Customer Satisfaction Index (CSI) measurement at Solo Technopark yielded an overall score of 82.05%, which is classified in the "Good" category. This value indicates that visitors are generally satisfied with the services provided, although there is still significant room for quality improvement (Rajendran & Suresh, 2017). The Assurance dimension scored the highest (84%), suggesting that aspects of trust and service security have been implemented quite well, reflecting staff professionalism and the operational stability of the facilities. However, the other five dimensions—Compliance, Tangible, Reliability, Empathy, and Responsiveness—remained at 81%. This indicates that while technical services and infrastructure are functional, visitors still perceive shortcomings in "soft service" aspects, such as staff empathy and responsiveness, as well as the comfort of physical facilities. From a public service management perspective, this can be interpreted as meaning that Solo Technopark is still in a middle-performance stage and requires improvement strategies focused on user needs and experience (user-centered service improvement). Optimizing underutilized spaces and providing staff training on personalized and responsive service will be crucial to elevating the CSI score into the "Very Good" category.

Table 5. CSI Results by CARTER Dimension Across Three Technoparks

No	CARTER Dimension	Solo Technopark			Bandung Technopark			Pekalongan Technopark		
		MIS	MSS	CSI	MIS	MSS	CSI	MIS	MSS	CSI
1	C1	3,27	3,41	81% (Good)	3,28	3,36	85% (Very Good)	3,59	3,50	87% (Good)
	C2	3,44	3,30		3,19	3,30		3,61	3,48	
	C3	3,63	3,11		3,38	3,42		3,45	3,47	
	C4	3,47	3,08		3,09	3,23		3,47	3,50	
	C5	3,44	3,41		3,27	3,30		3,48	3,52	
	C6	3,33	3,19		3,13	3,88				
2	A1	3,55	3,31	84% (Good)	3,36	3,30	84% (Good)	3,58	3,59	88% (Good)
	A2	3,53	3,23		3,44	3,36		3,39	3,45	
	A3	3,44	3,41		3,25	3,30		3,45	3,45	
	A4	3,56	3,50		3,50	3,42		3,45	3,50	
	A5				3,27	3,39				
3	R1	3,41	3,42	83% (Good)	3,42	3,36	84% (Good)	3,30	3,36	87% (Very Good)
	R2	3,50	3,28		3,28	3,30		3,55	3,58	
	R3	3,45	3,31		3,42	3,38		3,48	3,45	
	R4							3,45	3,48	
4	T1	3,45	3,36	81% (Good)	3,41	3,36	84% (Good)	3,53	3,55	88% (Excellent)
	T2	3,31	3,02		3,36	3,30		3,45	3,47	
	T3	3,53	3,23		3,25	3,30		3,50	3,52	
	T4	3,39	3,39		3,47	3,41		3,52	3,55	
	T5				3,47	3,39				
5	E1			83% (Good)	3,36	3,31	83% (Good)	3,44	3,53	88% (Excellent)
	E2				3,31	3,30		3,45	3,55	
	E3				3,34	3,30		3,50	3,44	
	E4				3,36	3,36		3,52	3,52	
6	RS1	3,33	3,27	81% (Good)	3,14	3,22	81% (Good)	3,47	3,45	87% (Very Good)
	RS2	3,44	3,23		3,16	3,25		3,44	3,38	
	RS3							3,53	3,50	
	RS4							3,63	3,61	

Bandung Technopark (BTP) obtained a Customer Satisfaction Index (CSI) score of 83.77%, placing it in the "Good" category, though it is very close to the "Very Good" threshold. This achievement indicates that the majority of visitors rate their experience at BTP positively, especially in the Compliance, Tangible, and Reliability dimensions, which scored between 84% and 85% (Ngo & Nguyen, 2016). The high score in Compliance suggests

that BTP has successfully established an operational system and physical facilities that adhere to modern service standards and regulations. Similarly, the high scores in Tangible and Reliability show that the technopark provides adequate and consistently functioning facilities.

However, much like Solo Technopark, the Responsiveness dimension is a weak point, with a score of only 81%. This signifies a gap between user expectations and the speed of staff response to visitor needs or complaints. Scientifically, this is consistent with the service quality theory by Parasuraman et al. (1988), where responsiveness is often the most sensitive dimension in service consumer perception. To establish BTP as a national benchmark for technopark services, improvements in the feedback information system, the use of digital service applications, and training programs for frontline staff based on real-time problem-solving are highly recommended.

Pekalongan Technopark (PTP) ranks highest in the customer satisfaction evaluation, with a Customer Satisfaction Index (CSI) score of 87.41%. This places it in the "Very Good" category, even approaching the "Excellent" classification. This score indicates that PTP has comprehensively met visitor expectations across all dimensions of the CARTER model (Deborah et al., 2023). Three dimensions—Assurance, Empathy, and Tangible—were the most prominent, each scoring 88%. This signifies that visitors feel comfortable, valued, and receive service that is both professional and based on their actual needs (Azzochrah et al., 2022). Theoretically, this suggests that PTP has internalized an adaptive and inclusive public service approach, reflecting the 'customer intimacy' concept discussed by Treacy and Wiersema (1993). The Compliance and Responsiveness dimensions also received high scores (87%), showing that PTP not only adheres to procedures and standards but is also responsive to community aspirations. This success is likely driven by PTP's focus on the local fishery and MSME (Micro, Small, and Medium Enterprises) sectors, making its services more targeted and contextual. In other words, PTP's success can serve as a model for integrating a region's strategic sector orientation, alignment with local needs, and the optimization of a user-experience-based service system.

Overall, Pekalongan Technopark is the technopark with the highest and most balanced level of satisfaction across all CARTER dimensions. In contrast, the other technoparks still show variations between dimensions, which is a crucial point for their management to address for comprehensive service quality improvement. This finding underscores the importance of continuous evaluation and user-experience-based service enhancement for technoparks to function optimally as centers for technology and innovation development.

The Conformity Level in the Importance-Performance Analysis (IPA) method is used to assess the extent to which the services provided meet visitor expectations. The comparison between the importance level and the performance level yields a conformity value, which serves as an indicator of whether the service is suitable, lacking, or even exceeds visitor expectations. A narrative description of the analysis results for the Conformity Level Index (TKI) and the service GAP at three technoparks—Solo Technopark (STP), Bandung Technopark (BTP), and Pekalongan Technopark (PTP)—based on the six service dimensions (Compliance, Assurance, Reliability, Tangible, Empathy, and Responsiveness) can be seen in the table 6.

Table 6. Suitability Index Level

Dimensions	STP		BTP		PTP	
	GAP (Avg. X- Avg Y)	TKI (%)	GAP (Avg. X- Avg Y)	TKI (%)	GAP (Avg. X- Avg Y)	TKI (%)
Compliance	0,14	104%	0,19	106%	-0,03	99%
Assurance	0,16	96%	-0,01	100%	0,03125	101%
Reliability	0,11	97%	-0,03	99%	0,02	101%
Tangible	0,17	96%	-0,03	99%	0,02	101%
Empathy	-0,17	96%	-0,03	99%	0,03	101%
Responsiveness	-0,13	96%	0,09	103%	-0,03	99%
Total	-0,01	96%	0,03	101%	0,01	100%

An analysis of user satisfaction across three Technoparks (Solo/STP, Bandung/BTP, and Pekalongan/PTP) reveals varied levels of performance. Solo Technopark (STP) performs slightly below expectations (GAP -0.01; TKI 96%), with its main weaknesses in Empathy and Responsiveness, warranting a focus on human-centered service training. In contrast, Bandung Technopark (BTP) is the top performer, exceeding visitor expectations

(GAP +0.03; TKI 101%) and serving as a benchmark due to its strong compliance with standards. Meanwhile, Pekalongan Technopark (PTP) delivers a balanced performance that meets expectations (GAP +0.01; TKI 100%), though there is an opportunity to create greater customer delight through technology-based service innovations. In conclusion, each park has specific areas for improvement: STP in personal service, PTP in digital innovation, and BTP standing as the quality benchmark.

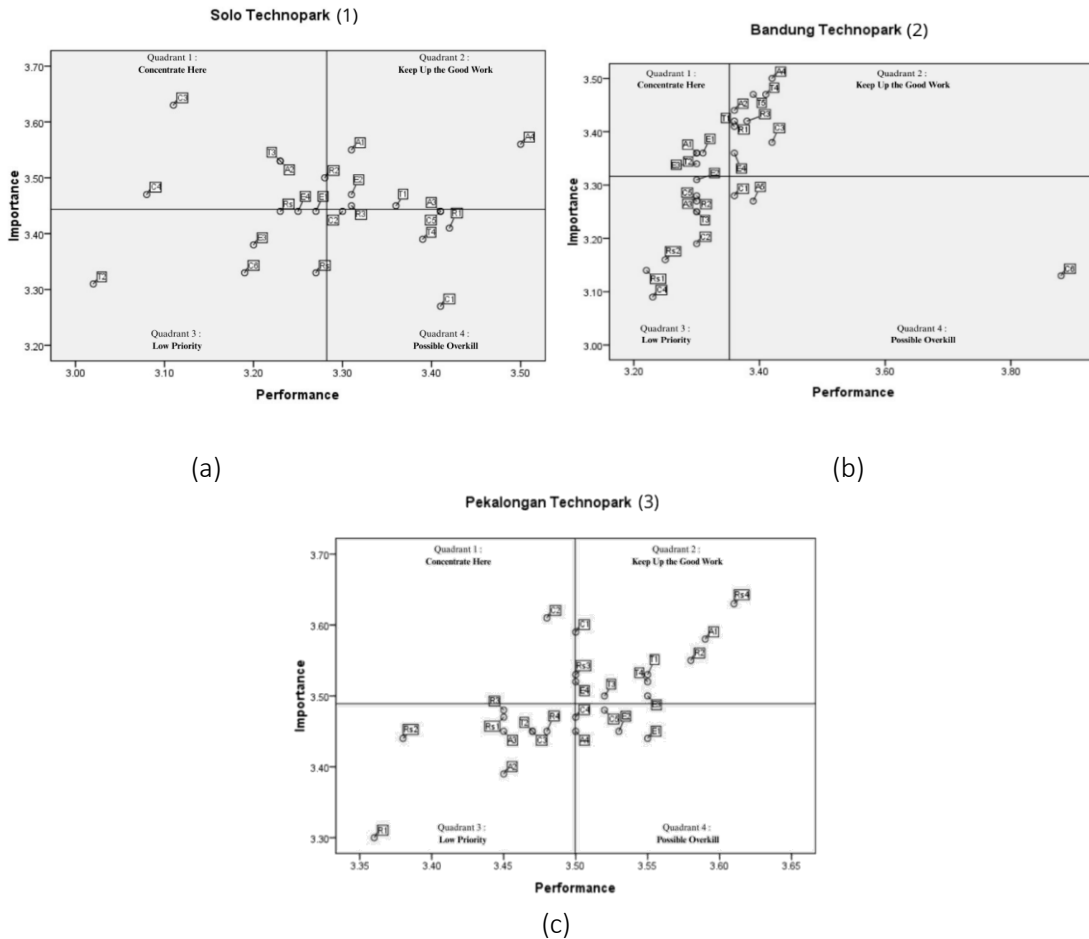


Figure 4. (a) Results IPA in Cartesius Diagram Solo Technopark (b) Results IPA in Cartesius Diagram Bandung Technopark (c) Results IPA in Cartesius Diagram Pekalongan Technopark

Based on an analysis of service quality, three Indonesian technoparks exhibit critical gaps in "Quadrant I" attributes, which are highly important to visitors but currently show low performance. Solo Technopark's primary deficiencies lie in its outdated technology, lack of educational activities, and inadequate physical facilities such as parking and clean amenities, negatively impacting user satisfaction according to the SERVQUAL and Technology Acceptance Models. Bandung Technopark struggles with staff responsiveness and empathy, revealing a weakness in human resource competence that prevents the formation of an emotional connection with visitors, contrary to public service excellence principles. Pekalongan Technopark fails to deliver on its core mission of supporting MSME innovation and lacks inclusivity, particularly in its services for disabled individuals and response to user requests, conflicting with smart governance principles. Strategic recommendations to address these issues across the technoparks include upgrading technological infrastructure, enhancing educational programs, conducting comprehensive staff training on soft skills, revitalizing physical facilities to meet universal accessibility standards, digitizing service response channels, and implementing a continuous performance-based monitoring and evaluation system.

Attributes in Quadrant II represent the core strengths of each technopark, being both highly important to users and having high performance, which are crucial for protecting their reputation. These strengths range from Solo Technopark's excellent safety, comfort, and fairness to Bandung Technopark's modern aesthetic and appealing environment and Pekalongan Technopark's strong mentorship programs and effective feedback

systems. The primary strategy for these attributes is to avoid complacency by continuously maintaining and enhancing them. This can be achieved through consistent operational procedures and staff training in Solo, scheduled facility maintenance and experience-based programming in Bandung, and ensuring mentor quality while digitizing feedback channels in Pekalongan. Ultimately, safeguarding these strengths through regular monitoring, user engagement, and continuous innovation is essential to prevent a decline in service perception and uphold high overall customer satisfaction.

Attributes in Quadrant III are of low importance to users and also have low performance. While not an urgent priority, these areas should be monitored and strategically managed for future development. The key recommendation for Solo Technopark is to improve its weak user communication channels to prevent long-term engagement issues, while enhancing secondary services like food options as an added value. Bandung Technopark is advised to proactively develop its underutilized educational and collaborative programs into a future strategic strength and improve its digital information systems. Meanwhile, Pekalongan Technopark should focus on gradually improving its administrative and technical support as a long-term investment to build a foundation capable of serving more complex users, such as tech startups, beyond its current MSME focus.

Attributes in Quadrant IV are services with high performance but are considered less important by users, which indicates potential inefficiency or "over-servicing." This means resources are allocated to areas that are not the users' main priorities. The recommended strategy is not to reduce these services, but rather to reorient them. For instance, Solo Technopark can repackage features like workspaces and collaboration facilities as long-term selling points within its incubation programs. Bandung Technopark should maintain these services as a basic standard and reallocate resources to more urgent areas (Quadrant I). Meanwhile, Pekalongan Technopark can leverage its strengths, such as patient staff, as a marketing tool for investors or partners, while also improving communication so that current users also appreciate their value.

## CONCLUSION

This research concludes that visitor satisfaction levels at three Indonesian technoparks are generally favorable, with Customer Satisfaction Index (CSI) scores of 91.9% for Bandung, 88.4% for Pekalongan, and 82.05% for Solo. The Assurance and Reliability dimensions are the primary contributors to satisfaction; however, performance gaps persist, particularly within the Responsiveness and Empathy dimensions at Solo Technopark, indicating that visitor expectations are not being fully met. An Importance-Performance Analysis (IPA) identifies priority criteria for improvement (Quadrant I attributes), which include access to technology, staff initiative, facility cleanliness, and support for educational and innovation community activities. Consequently, recommended developmental strategies focus on enhancing human resource quality through empathy-based service training, modernizing technological and physical infrastructure for better accessibility, strengthening inclusive educational and collaborative programs, digitalizing service and user feedback systems, and optimizing resource allocation towards attributes with a high impact on satisfaction. The implementation of these strategies is anticipated to enhance the technoparks' competitiveness as innovation hubs that excel in both modern facilities and public service delivery. Theoretically, this study contributes by validating the applicability of the CARTER model beyond its original Islamic banking context into public innovation hubs, while the integration of CSI, IPA, and spatial analysis offers a methodological advancement for multi-site service quality evaluation. Furthermore, the comparative design across technoparks with distinct sectoral orientations enriches the understanding of how local ecosystem characteristics shape visitor satisfaction.

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## DATA AVAILABILITY

The data used in this study are not publicly available due to privacy considerations and institutional data management policies. Data may be made available upon reasonable request to the corresponding author.

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