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Unlocking Indonesia's Data Center Potential: Location Advantage and Cost Efficiency

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Abstract: The data center industry is anticipated to grow significantly, with a projected 28% increase in demand by 2031. Indonesia is expected to play a major role in this expansion, with its potential IT workload demand for data centers predicted to hit 40% of the total regional IT workload in Southeast Asia. This study employs a descriptive-analytical (exploratory) method, comparatively analyze of Batam and Johor as potential Data Center location, using SWOT analysis and Scoring method with selection criteria matrix focusing on attributes, including subsea cable access, regional demand aggregation, renewable energy, and disaster resilience, alongside cost differences encompassing electricity, land, logistics, labor, and more. Results indicate that Batam generally outperforms Johor as a potential data center site, particularly considering the projected total data center market demand in Batam, reaching 311 MW by 2032, with 122 MW from local demand and 189 MW from spillover & returning demand from the regional market.

Keyword: Data Center Development, SWOT Analysis, IT Infrastructure, Renewable Energy, Southeast Asia Regional Demand.

INTRODUCTION

The demand for data center businesses in Indonesia is expected to experience significant growth potential up to the year 2030. When compared with other Southeast Asian countries such as Thailand, Vietnam, and Malaysia, the potential demand for data center business in Indonesia by 2030 is estimated to reach 1,600 MW. Of this total demand, only 1,083 MW can be met by local data center players in Indonesia, while the remaining approximately 500 MW will be fulfilled from outside Indonesia (regionally). The market demand growth from 2021 to 2030, with a CAGR of 28%, is largely driven by many of media usage (Starosielski, 2019; Cubitt, 2016; Parikka 2015), with an IT Load capacity of 446 MW by 2030. Additionally, demand from the enterprise segment is also estimated to grow significantly, where by 2030, the IT Load capacity could reach 395 MW.

The use of IT workload in the region is projected to grow by 16% annually and will reach 4.6 GW by 2031, supported by the growth of internet users (projected growth from 54% in 2019 to 63% in 2026), IT transformation across various fields, growth in cloud and content (Mosco, 2014), as well as the rate of Internet of Things (IoT) usage. The majority

(approximately 40%) of IT workload contributions come from Indonesia as the country with the largest population and an internet penetration rate of 74% of the total population, followed by the Philippines, Thailand, and Vietnam.

Singapore, as a regional connectivity hub, faces supply constraints with restrictions on new data center constructions (limited to a maximum of 60MW for the next 18 months) following the lifting of a moratorium by the Singapore government in January 2022. Moreover, regional demand growth is predicted to outpace supply growth, leading to potential regional data center demand that cannot be served by Singapore's data center players (spill-over demand) moving to Batam and Johor, considering their close proximity to Singapore.

The majority of IT workload demand in Indonesia comes from digital native businesses (DNBs) such as Gojek, Bukalapak, Traveloka, and social media. These DNBs generally use cloud services provided by AWS and other Cloud Service Providers (CSPs) from China. For social media, which mainly comes from Facebook and other digital content like YouTube, Google Cloud is used. In the B2B segment, cloud services provision is dominated by Microsoft and Google, which usually offer bundling with their Software as a Service (SaaS) products and services. Thus, the need for IT Load capacity in Indonesia is projected to primarily come from Google Cloud, AWS, Microsoft Azure, and Chinese cloud providers (Vonderau, 2017).

IT workload demand in Indonesia is projected to grow by 17% per year, with an estimated total IT workload demand of 1,857 MW by 2031. This demand, apart from coming from Indonesia, also includes spill-over demand from Singapore that cannot be met by existing data center service providers due to limited supply capacity in Singapore. Of the total estimated IT workload demand in Indonesia by 2031 of 1,857 MW, about 601 MW (~32% of the total IT workload demand in Indonesia) will be met by data centers owned by the CSPs (Google, AWS, Microsoft) and OTT (Facebook) themselves, as well as data center service providers abroad (Vonderau, 2017). Thus, about 1,256 MW (~68% of the total IT workload demand in Indonesia) by 2031, with a growth of 33%, will be fulfilled by Multi-Tenant Data Centers (MTDC) in Indonesia. Of this 1,256 MW, demand is divided among facility Colo, Hyperscale, and Edge segments. The Colo segment currently contributes the largest demand, but by 2031, the Hyperscale segment will continue to grow and support nearly 50% of the total IT workload demand for MTDC.

As of 2022, the supply capacity of data centers in Indonesia reached 136 MW, of which 86 MW came from the Hyperscale segment owned by DCI, NTT, Telkom, and Atria. The largest supply capacity comes from DCI, amounting to 37 MW. By 2025, it is estimated that there will be an additional supply capacity of approximately 228 MW, mainly from BDX and DCI. About 45 MW of this will be built in Batam by three data center service companies: Aesler, Princeton, and GDS. Then, in the long term, there will be an additional ~613 MW from several data center service providers, so the total supply capacity in Indonesia is estimated to reach ~977 MW, predominantly in the Hyperscale segment. From the comparison between the estimated supply capacity in 2025 and the demand in 2031, there appears to be a potential unmet demand in Indonesia of approximately 892 MW.

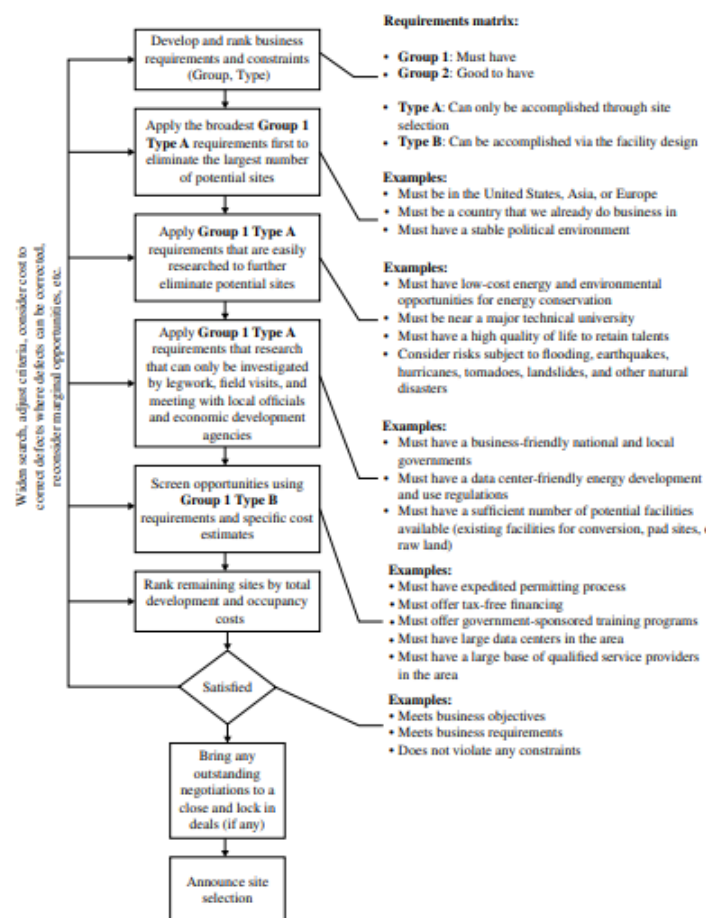
Looking The opportunities, this study will explore Indonesia's potential to capitalize on the projected high demand for data centers in the country, specifically in light of the regional demand aggregation or spillover demand from Singapore following the government's lifting of the moratorium in January 2022 (which limits new data center construction to a maximum of 60MW over the next 18 months). It begins by discussing the criteria required for a location to build a data center and limits its analysis by comparing Batam and Johor as the most potential data center location candidates, considering their close proximity to Singapore. Followed up by scoring, using matrix focusing on attributes, including subsea cable access,

regional demand aggregation, renewable energy, and disaster resilience, alongside Cost aspects (Crawford, 2021) encompassing electricity, land, logistics, labor, and more.

This research aims to provide references for domestic companies in search of potential locations to leverage and maximize the value of their data center business portfolio in Indonesia, potentially attracting leading companies or tech giants such as Google, Alibaba, Amazon, Microsoft to compete and invest in Indonesia, making it a potential market expected to achieve higher multiple EV/EBITDA through unlocking the value of the data center business.

METHOD

This study adopts a comprehensive descriptive-analytical (exploratory) approach, integrating SWOT analysis and a scoring matrix to compare Batam and Johor as potential locations for data center establishment. The methodology centers on identifying key attributes or criteria crucial for assessing the viability of a site as a suitable data center location. These evaluation criteria include, but are not limited to, the availability of necessary infrastructure, access to submarine cables, the potential for regional demand aggregation, renewable energy sources, and resilience to disasters. Cost factors such as electricity, land, logistics, labor, and other relevant expenses are also critically assessed. Data collection methodologies encompass both fieldwork and extensive library research, engaging with a variety of sources like academic literature, regulatory documents, books, theses, journal articles, and other pertinent materials to construct a logical and systematic framework for both internal and external company analysis (Yunus, 2016).



Source: K.J. Baudry, Inc

Picture 1. D Source: K.J. Baudry, Inc Ata Center Site Search and Selection Process

The strategic planning aspect of the research reflects a systematic process where critical cross-functional and cross-level decisions within the company are made, implemented, and controlled. This strategic planning system addresses four foundational questions: the mission (our direction), the strategy (our path), the action plan (our blueprint), and the performance tracking mechanism (our control). This framework facilitates a meticulous investigation into each relevant aspect, enabling a well-considered determination of a location's suitability in alignment with the specific needs and goals of the company or project in question (Yunus, 2016).

The research adheres to the framework, which segments the investigation into four principal activities : Data Collection, Determining Potential Locations, Location Selection Criteria setting and Analysis & Conclusion (HWAIIYU GENG, P.E, 2021, p. 370). Initially, data collection is undertaken through rigorous fieldwork and a comprehensive review of literature, aiming to amass data on potential sites for data centers. This phase employs a diverse range of information sources to facilitate a detailed analysis that considers both internal factors and external conditions.

The study then narrows its focus to Johor and Batam, selected as the primary locations for comparison due to their strategic potential as data center hubs. This decision is influenced by their geographical proximity to Singapore and the resultant spillover of service demand. Subsequently, the evaluation process for these potential locations scrutinizes geographical, infrastructural, and economic aspects to thoroughly assess each site's suitability for data center development.

Finally, the research utilizes a SWOT analysis coupled with a comparative location matrix. This dual approach enables a critical evaluation of the strengths, weaknesses, opportunities, and threats associated with each location. Moreover, a scoring system quantifies these evaluations, ensuring that the decision-making process is informed and objective, the higher the score, the more suitable the location is deemed to be, serving as a foundational basis in the decision-making process for selecting the most appropriate location. Through this methodology, the chosen location is guaranteed to align with the organization's internal strengths and capitalize on external opportunities, while also anticipating and mitigating potential threats and weaknesses. This structured and strategic approach underscores the research's commitment to selecting the most appropriate data center location.

Table 1. Matriks location comparation between batam and johor.

Komparasi Lokasi				
No	Kriteria seleksi	Bobot	Rating Kriteria	
			Batam	Johor
1	Lokasi Geografi	5	1-5	1-5
2	Demand agregasi Regional	4	1-5	1-5
3	Ketersediaan Konektivitas	5	1-5	1-5
4	Ketersediaan Listik	5	1-5	1-5
5	Ketersediaan Energi terbarukan	3	1-5	1-5
6	Risiko Alam (Bencana)	5	1-5	1-5
7	Kemudahan Logistik	4	1-5	1-5
8	Ketersediaan tenaga kerja	4	1-5	1-5
9	Biaya property	3	1-5	1-5
10	Biaya listrik	4	1-5	1-5
11	Biaya logistik	3	1-5	1-5
12	Biaya tenaga kerja	3	1-5	1-5
13	Biaya lain-lain	2	1-5	1-5

The chapter culminates in a strategic examination that enables a rational approach to decision-making, reflecting minimal deviation from strategic objectives and ensuring a comprehensive understanding of how various functional areas interconnect and contribute towards achieving the corporate mission. This understanding is pivotal for top management

tasked with evaluating the company's overall performance and strategic direction (Yunus, 2016).

In the determination of data center locations, the assigned weights to various selection criteria reflect their relevance and impact on operational sustainability. Geographic location, connectivity availability, electrical supply, and natural disaster risks receive the highest weightings (5) due to their crucial roles in optimizing operations and minimizing risks, as emphasized by sources like Uptime Institute (2020) and Cisco (2020). Regional demand aggregation, logistical accessibility, labor availability, and electricity costs are each assigned a weight of (4), highlighting their significant contributions to operational sustainability, supported by insights from Gartner (2021), Deloitte (2021), and the Bureau of Labor Statistics (2021). Renewable energy availability, property costs, logistics costs, and labor costs, with weights of (3), are deemed important but offer greater management flexibility, as noted by Renewable Energy World (2021) and CBRE (2021). Miscellaneous costs are given the lowest weight (2), reflecting their relatively minor significance compared to other primary factors, corroborated by CBRE (2021). This weighting analysis aims to support efficient and effective location decision-making for data centers, integrating established industry insights.

RESULTS AND DISCUSSION

In the rapidly evolving landscape of the digital economy, the strategic positioning of data centers plays a crucial role in regional connectivity and the global data management ecosystem. The burgeoning demand for data center services, propelled by the digital transformation of businesses and the proliferation of cloud computing, necessitates a careful examination of potential hubs that can support this growth. This chapter presents an in-depth feasibility study analyzing Batam and Johor as potential hubs to accommodate the spillover demand for data center services from Singapore, using SWOT analysis and Matrix Scoring Assessment.

The SWOT analysis, a cornerstone of strategic management, assesses the strengths, weaknesses, opportunities, and threats associated with each location, providing a holistic view that is vital for strategic planning. This analysis helps identify internal capabilities and external environmental dynamics affecting operational sustainability. An initial SWOT analysis, serving as a foundational tool in strategic management practices, is instrumental in aiding organizations to map out their strategic groundwork. This systematic framework reveals the strengths, weaknesses, opportunities, and threats surrounding an organization from both internal and external environments. By adopting a Systems Approach, which recognizes an organization as an entity interacting with its surrounding environment, the SWAT analysis provides a holistic perspective crucial for strategic planning. This understanding not only facilitates the identification of relevant internal resources and capabilities but also clarifies the dynamics of the external environment affecting operations and sustainability. Therefore, within the context of this thesis, the SWOT analysis will serve as an analytical bridge to identify and evaluate the critical factors influencing the potential of Batam and Johor as centers for accommodating the spillover data center demand from Singapore. It starts from the premise that a thorough understanding of the strengths, weaknesses, opportunities, and threats faced by these locations will strengthen their strategic foundation in facing regional market dynamics.

As potential sites for developing data centers serving spillovers from Singapore, Batam, part of the Republic of Indonesia, exhibits significant stability with proactive government policies inviting and supporting foreign investment. Batam offers efficient access via ferry transportation and is supported by strong connections through eight submarine cables. Moreover, ambitious plans for the development of floating solar farms and energy storage systems add value to Batam's commitment to innovation and sustainability, where the

adoption of green technology and innovation in data center management is a key factor in attracting investment. Geographically, Batam's proximity to Singapore positions it as a strategic regional hub, enabling effective synergy and connectivity on a regional scale. Conversely, Johor, under Malaysia's jurisdiction, displays equally important strengths. The business environment in Johor ranks better in ease of doing business indexes compared to Batam, combined with competitive tax and VAT incentive structures, creating a favorable climate for investment and business growth. Johor also offers superior accessibility through bridge connectivity, supported by four submarine cables, and its strategic proximity to Singapore benefits business operations.

Batam and Johor each face a distinctive set of challenges and opportunities as potential sites for data centers. Batam is hindered by significant logistical costs associated with the procurement and shipment of equipment due to infrastructural limitations and its geographical distance from major equipment sources, which increase both operational and capital expenses. Additionally, the quality of life for employees in Batam tails challenges when compared to Singapore, which offers a higher standard of living and more developed infrastructure. On the other hand, Johor, despite its strengths, contends with both man-made and natural risks linked to its proximity to Singapore, facing threats such as sea-level rise and flooding. Furthermore, while Johor benefits from good access, its connectivity lags behind Batam's, potentially impacting data center performance and reliability due to fewer and lower quality submarine cable connections.

Despite these challenges, both regions hold promising opportunities for the development of data centers. Batam is well-positioned to capitalize on the growing trend towards sustainable and green energy solutions, with ongoing projects for renewable energy placing it at the forefront of efficient and environmentally friendly data center operations. Its strategic role as a major connectivity hub also opens up expansive prospects into the wider Indonesian market, enabling potential integration of the national digital ecosystem into the global network. Johor, supported by favorable Malaysian government policies, sees significant potential in further developing its infrastructure and services. This includes building new facilities and upgrading existing ones to enhance data center efficiency and effectiveness. Investments aimed at improving the quality of life for its workforce could make Johor a more attractive location for high-quality talent, bolstering its competitive edge.

Table 2. Matriks location comparison between batam and johor

	STRENGTHS		WEAKNESSES	
	BATAM	JOHOR	BATAM	JOHOR
INTERNAL	✓ <u>Stabilitas politik Indonesia didukung dengan insentif pemerintah atas investasi asing.</u> ✓ <u>Akses mudah via ferry dan konektivitas yang kuat dengan 8 submarine cables</u> ✓ <u>Rencana pembangunan ladang surya terapan dan sistem penyimpanan energi</u>	✓ <u>Ranking yang lebih tinggi dalam indeks kemudahan berbisnis dengan insentif pajak dan PPN yang kompetitif.</u> ✓ <u>Biaya konstruksi sipil yang lebih rendah</u> ✓ <u>ketergantungan pada tenaga kerja lokal mengurangi biaya operasional.</u>	✓ <u>Biaya logistik yang lebih tinggi, terutama untuk pengadaan dan pengiriman peralatan.</u> ✓ <u>Potensi tantangan dalam menarik tenaga kerja internasional, mengingat perbedaan dalam fasilitas dan layanan dibandingkan dengan Singapura.</u>	✓ <u>Kedekatan geografis dengan Singapura menimbulkan risiko alam serupa, seperti banjir atau kenaikan permukaan laut</u> ✓ <u>konektivitas kurang optimal dengan jumlah submarine cables yang lebih sedikit.</u>
EKSTERNAL	OPPORTUNITIES		THREATS	
	BATAM	JOHOR	BATAM	JOHOR
	✓ <u>Proyek-proyek energi terbarukan besar yang sedang berlangsung, menawarkan peluang untuk Green Data Center.</u> ✓ <u>Posisi sebagai major connectivity hub di Indonesia menawarkan peluang ekspansi ke pasar Indonesia yang lebih luas.</u>	✓ <u>Potensi untuk pengembangan atas gap infrastruktur dan layanan yang lebih lanjut,</u> ✓ <u>Dengan fasilitas dan layanan yang lebih unggul dapat menarik tenaga kerja berkualitas tinggi.</u>	✓ <u>Meskipun ada proyek besar, terdapat tantangan pada keberlanjutan dan ketersediaan jangka panjang energi terbarukan</u>	✓ <u>Persaingan yang meningkat dari lokasi lain di Asia Tenggara yang juga menawarkan insentif untuk Data Center.</u>

However, Batam faces potential threats from significant policy shifts that could disrupt the business incentive landscape, highlighting the critical nature of policy stability in attracting and retaining foreign investment. Similarly, the sustainability of renewable energy sources remains a pressing concern amidst growing energy demands and the stringent reliability requirements of data center operations. Johor, in its turn, deals with intense regional competition as various Southeast Asian locales vie to attract data centers through enticing incentives and favorable policies. These dynamics necessitate strategic planning and proactive management to mitigate risks and leverage opportunities effectively, ensuring that Batam and Johor can both thrive as key players in the regional data center market.

In this Matrix Scoring Analysis, we evaluate the suitability of Batam and Johor as potential locations for data center development. The comprehensive matrix integrates well-defined selection criteria reflecting each location's contributions to the final decision-making process. Attributes are weighted based on their significance, with ratings derived from observations, interviews, discussions, and analysis of relevant literature and theory. This methodology quantifies various factors into numerical values, facilitating objective comparisons between locations.

Batam and Johor are strategically positioned near Singapore, which is facing a supply constraint due to a moratorium lifting that restricts new data center construction to a maximum of 60MW for the next 18 months. As a result, there is a significant spill-over demand for data center services from the regional hub, which both locations could potentially absorb. Batam offers easy access via hourly ferry services, taking between 45-70 minutes, and is already familiar to businesses headquartered in Singapore. Conversely, Johor provides comparable benefits in terms of location and accessibility, being just a 20-minute drive from Singapore, with a supportive infrastructure that bolsters its business operations.

Connectivity is a critical component within data centers for optimizing performance, efficiency, and scalability. Batam shows superior connectivity to Singapore with eight submarine cables compared to Johor's four, significantly enhancing its appeal as a major connectivity hub in Indonesia. On electricity availability, Batam is poised to support substantial data center operations with announced large-scale projects and sufficient power supply from dual PLN substations. Plans to develop up to 400MW of data center capacity in a 167-hectare digital park underscore Batam's commitment to supporting long-term energy needs for data centers.

The focus on renewable energy is crucial as data center industry consumption, accounting for over 1% of the world's electricity, is expected to rise to 8% by 2030. Batam is advancing in this area with significant initiatives like the planned \$2 billion Sunseap Group project, which aims to establish a floating solar farm and the world's largest energy storage system on Duriangkang Reservoir. This project exemplifies a shift towards large-scale solar projects and energy storage solutions, highlighting the growing importance of renewable energy in sustaining environmentally friendly regional growth.

In considering natural disaster risks, Batam faces potential seismic activities, requiring earthquake-resistant construction, whereas Johor, with a lower risk of natural disasters, still needs to account for flooding and long-term climate change impacts.

Cost analysis for land and property in Batam reveals significant variations, depending on location and development potential, whereas Johor shows a steadier pricing structure, potentially more attractive to long-term investors. Operational and material costs in Batam are considerably higher due to logistics, emphasizing the need for strategic planning to mitigate these costs.

Table 3. Copmaration matriks location criteria between batam and johor.

Komparasi Lokasi						
No	Kriteria seleksi	Bobot	Rating Kriteria			
			Batam	Nilai	Johor	Nilai
1	Lokasi Geografi	5	4	20	4	20
2	Demand agregasi Regional	4	5	20	4	16
3	Ketersediaan Konektivitas	5	5	25	3	15
4	Ketersediaan Listik	5	5	25	4	20
5	Ketersediaan Energi terbarukan	3	5	15	4	12
6	Risiko Alam (Bencana)	5	3	15	4	20
7	Kemudahan Logistik	4	3	12	4	16
8	Ketersediaan tenaga kerja	4	4	16	4	16
9	Biaya property	3	3	9	4	12
10	Biaya listrik	4	3	12	2	8
11	Biaya logistik	3	3	9	4	12
12	Biaya tenaga kerja	3	3	9	2	6
13	Biaya lain-lain	2	3	6	3	6
TOTAL				193		179

Operational and material costs highlight the logistical differences between Batam and Johor, with Batam facing greater challenges in logistics and delivery, which directly affect the cost of data center construction. Considering these factors, both locations offer distinct advantages for data center development, dependent on the strategy and priorities of investors. A holistic approach to this evaluation is essential to ensure that data center investments not only meet current market needs but also support future growth and technological innovation.

CONCLUSION

In selecting a suitable location for the construction of a Data Center, there are several crucial factors that need to be considered to ensure long-term success and operational efficiency. Connectivity is a primary consideration; the chosen location must have good access to submarine cables, which are vital for fast and reliable connectivity and minimizing latency. Additionally, the availability and stability of resources are key considerations, including a stable electricity supply and the potential for renewable energy use, which not only supports sustainable operations but also potentially leverages fiscal incentives.

Another important aspect is the risk of natural disasters. Choosing a location with a low risk of natural disasters is essential to reduce potential downtime and damage to infrastructure. Operational costs, including land, property, and labor costs, must also be thoroughly considered as they have a direct impact on the profitability of the Data Center. From a regulatory perspective, a deep understanding of local and national policies and regulations related to Data Center operations is crucial for compliance and for utilizing government incentives. The regional market demand and potential growth should also be analyzed to evaluate the sustainability of the investment. Furthermore, the socioeconomic conditions and quality of life in potential areas play a role in the ability to recruit and retain quality workforce.

Considering these factors will enable companies to maximize operational performance, minimize risks, and ensure adaptability in the constantly changing market dynamics. Thus, the decision on location becomes an integral strategy that supports the long-term success of Data Center operations. In terms of criteria, Batam and Johor meet the qualifications as Data Center locations to accommodate the spill-over demand from Singapore. A detailed analysis using SWOT and scoring matrix methods revealed that Batam and Johor each have their advantages and challenges in the context of data center development. This evaluation provides a strong basis for making optimal strategic decisions for data center development. Batam has advantages in terms of connectivity with eight submarine cables that connect it directly to Singapore, providing high speed and reliability. Additionally, Batam shows great

initiative in providing a stable and adequate electricity supply through major projects like those in Nongqawali Digital Park. Ambitious projects such as floating solar farms demonstrate Batam's commitment to using renewable energy that can support sustainable data center operations. Batam also has the potential to capture overflow demand from Singapore, enhancing market potential and operational sustainability. However, Batam faces challenges such as high logistics costs due to local provider limitations and the need to import most of the equipment from abroad. Moreover, Batam also faces earthquake risks and extreme weather conditions that require disaster-resistant building design and construction.

On the other hand, Johor has a better business environment in the ease of doing business index, with a competitive tax incentive structure. Johor's accessibility is also good with a bridge connection and four submarine cables directly connecting it to Singapore. Johor offers better quality of life with facilities and services that support employee welfare. However, Johor faces stiff competition from other locations in Southeast Asia that are also trying to attract investment in digital infrastructure. Additionally, electricity costs in Johor are higher compared to Batam during peak periods.

The comprehensive advantages of Batam demonstrate it as a more advantageous location for businesses looking to expand in the region, providing insights into critical factors that influence strategic decisions, opportunities for domestic companies to utilize and sell this location for strategic partnerships with global companies to achieve the unlocking of the Data Center portfolio in Indonesia.

For Batam, it is recommended to develop local logistics infrastructure to reduce reliance on imports and suppress logistics costs. Additionally, implementing disaster-resistant building designs and effective natural disaster risk mitigation systems is necessary to reduce potential operational disruptions. Batam should also continue and expand collaboration with Singapore and international parties for larger and sustainable renewable energy projects. Meanwhile, Johor should increase the number and quality of submarine cable connections to optimize data center performance. Investments in the development of information and communication technology infrastructure and improved service facilities to attract more foreign investment are highly recommended. Additionally, Johor needs to develop a competitive strategy to attract investments, including offering additional business incentives and enhancing regulatory stability.

It is advisable to enhance regional cooperation between Batam, Johor, and Singapore to form an integrated and mutually supportive digital ecosystem. Focusing on adopting green technologies and innovative solutions for efficient and environmentally friendly data center operations is also crucial. Additionally, investment in training and developing local workforce in Batam and Johor should be increased to enhance their skills and competitiveness. With a measured approach and a future-oriented strategy, Batam and Johor can position themselves as major data centers in the region, supporting the growth and innovation of the digital industry sustainably.

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