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Research Paper

Advancing Competitive Positioning in The Photovoltaic Module Market with System Thinking: A Case of PT. Indonesia Solar Global

Zaeny Ahmad[1]*, Utomo Sarjono Putro[1]
[1] Bandung Institute of Technology, Indonesia

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Abstract

Facing intense global competition and evolving regulatory challenges, the photovoltaic (PV) module market demands innovative strategies for competitive positioning, which this study addresses by applying systems thinking to uncover and analyze the complex interdependencies within the industry. Utilizing qualitative methods, this study engages key stakeholders through semi-structured interviews and employs Causal Loop Diagrams (CLDs) to ensure a rigorous and reliable analysis of the strategic and operational factors impacting PT. Indonesia Solar Global (ISG) within the PV module market. This study introduces a novel application of systems thinking to the photovoltaic module market, revealing how it can strategically enhance competitive positioning and operational efficiency, thus offering significant theoretical and practical contributions to the field of strategic management within renewable energy sectors. The findings reveal that strategic applications of systems thinking enable ISG to navigate complex market dynamics effectively, optimizing production efficiencies, and enhancing competitive strategies against global competitors. This study not only addresses ISG's immediate challenges but also contributes to the broader discourse on strategic management within the renewable energy sector, showcasing the practical application of systems thinking in resolving industry-specific issues.

Keywords *Systems Thinking, Photovoltaic Modules, Strategic Management, Competitive Strategy, Renewable Energy*

INTRODUCTION

The global photovoltaic (PV) market is expanding at an unprecedented pace, with installations reaching record levels due to surging demand, particularly in China, as highlighted in the Global PV Market Outlook report by Chase (2023). This expansion presents a unique blend of opportunities and challenges, especially in terms of pricing and innovation pressure on manufacturers, suggesting a dynamic competitive landscape. Indonesia's ambitions in solar PV manufacturing are supported by domestic content requirements and other incentives aimed at nurturing local industry. Despite these initiatives, the market remains nascent with limited local demand and intense competition from global giants, primarily China (Caroline, 2022). This scenario offers a compelling case for the application of systems thinking to understand and navigate the complexities of the photovoltaic module market.

Systems thinking has been posited as a paradigm shift necessary for addressing complex sustainability challenges effectively (Voulvoulis et al., 2022). This approach underscores the interconnections within systems, advocating for a holistic perspective in policy-making and industry strategy, especially relevant in technology-driven markets like photovoltaics where environmental, technological, and social factors converge. The relevance of systems thinking in shaping competitive strategies in the PV industry is further underscored by the IEA Photovoltaic Power Systems Program's PVPS Trends Report (2023), which illustrates the rapid integration and evolution of PV systems across global markets, emphasizing the need for adaptive strategies in

Corresponding author's email: zaeny_ahmad@sbm-itb.ac.id

response to technological advancements and market dynamics.

Despite Indonesia's rich solar resources and the strategic importance of the PV market, the country lags behind in solar PV deployment compared to its regional counterparts due to infrastructural and regulatory challenges (Agarwal et al., 2023). Therefore, learning from regional successes could provide valuable insights into optimizing local manufacturing capabilities and expanding market reach (Kennedy, 2023). Additionally, the assessment of various business challenges and success factors by Pagtalunan et al. (2023) offers a broader perspective on entrepreneurial aspects in technology-driven markets, emphasizing the importance of strategic marketing and competitive pricing in achieving market penetration and brand loyalty. Moreover, critical systems thinking, which evolved to include an understanding of power relations and value judgments within systems, provides a lens through which the photovoltaic market's complexities can be dissected and addressed (Midgley & Rajagopalan, 2021). This perspective is crucial in identifying leverage points that can lead to significant competitive advantages within global and local PV markets.

Given this backdrop, this study seeks to explore how PT. Indonesia Solar Global can apply systems thinking to enhance its competitive positioning within the photovoltaic module market. The research will address the following questions: 1) How can systems thinking facilitate a better understanding of the competitive dynamics in the PV market? 2) What strategic interventions are necessary for ISG to effectively leverage its market position?

This study aims to delineate a clear pathway for integrating systems thinking into strategic management within the photovoltaic sector, providing both theoretical contributions and practical implications for firms operating in emerging markets.

LITERATURE REVIEW

Indonesian Photovoltaic (PV) Module Market

The Indonesian photovoltaic (PV) module market is poised at a critical juncture, with the potential to significantly contribute to the country's renewable energy mix. A report by IESR (2022) underlines Indonesia's commitment to achieving a 23% renewable energy share by 2025 and full decarbonization by 2060. Despite the substantial decrease in the levelized cost of electricity from solar sources, which fell by 88% from 2010 to 2021, deployment has been sluggish, necessitating urgent reforms to expedite the growth of solar energy, particularly in rooftop and utility-scale projects (IESR, 2022). Mordor Intelligence (2023) supports this outlook by predicting a robust annual growth rate of over 10% for Indonesia's solar market, driven by diminishing costs and escalating demand for renewable energy. However, the heavy reliance on fossil fuels and setbacks from the COVID-19 pandemic pose significant barriers. This analysis emphasizes a shift toward off-grid solutions, particularly in remote and island areas, highlighting both challenges and opportunities within the market. In addition, another report by IESR & BloombergNEF (2021) illustrates that while Indonesia boasts substantial solar potential, it remains largely untapped due to persistent policy and regulatory challenges. The report advocates enhanced governmental support, improved financing mechanisms, and fortification of the local solar manufacturing industry as critical steps toward leveraging this potential.

Simanjuntak (2022) criticizes the slow pace of policy implementation that has marred the development of the solar sector despite its capability to swiftly and sustainably meet a significant portion of the country's energy needs. Similarly, a report by (IESR, 2021) charts Indonesia's extensive renewable energy potential, surpassing previous official estimates, and calls for more aggressive renewable energy targets to align with international climate commitments.

Globally, studies like those by Joshi and Yenneti (2020) on community solar initiatives in India demonstrate the model's efficacy in alleviating energy poverty and advancing sustainability,

which could serve as a blueprint for similar initiatives in Indonesia. Moreover, research on the diffusion of innovative technologies through systems thinking, as explored by Esfandabadi and Ranjbari (2023) and Rust et al. (2023), offers methodological insights that could be pivotal for understanding and enhancing the adoption of PV technologies in Indonesia. Lastly, the study by Xin-gang et al. (2021) on China's PV industry underscores the significant role that government policies and R&D incentives play in fostering industry growth and sustainability, suggesting parallels for Indonesia's burgeoning solar market.

Competitive Positioning within the PV Module Market

Competitive positioning in the photovoltaic (PV) module market is intricately linked to how firms manage and leverage their resources in response to technological and market changes. Freeman et al. (2021) enhanced our understanding by integrating stakeholder theory with the resource-based view (RBV), suggesting that aligning resource management strategies with stakeholder interests can significantly bolster competitive advantages. This perspective is particularly relevant in the renewable energy sector, where sustainability and cooperation are paramount. However, technological disruptions are reshaping competitive landscapes across industries, including the PV module market. Kim et al. (2021) explore how digital technologies disrupt existing competitive positions in the automotive sector, a phenomenon equally applicable to the PV industry, where advancements in technology continually shift market dynamics. These disruptions compel companies to innovate, impacting competitive strategies profoundly.

The applicability of traditional competitive analysis frameworks like Porter's Five Forces is questioned by Isabelle et al. (2020), who argue for a revised framework that incorporates globalization, digitalization, and innovation. This augmented model is critical for understanding the competitive strategies in the evolving PV module market, where such forces are increasingly relevant. While Ammirato et al. (2022) discuss the utility of system dynamics diagrams in fostering business model innovation, which can provide PV firms insights into dynamic market conditions and resource interactions, thereby aiding in the development of competitive strategies that anticipate market and technological shifts. In addition, Hassan et al. (2022) highlight the Blue Ocean Strategy's relevance to the PV module market, advocating for creating new market spaces that make competition irrelevant. This approach is crucial for PV companies looking to differentiate themselves through innovation in technology, customer service, or new applications of PV modules.

Botelho et al. (2021) identified innovative business models as pivotal for integrating prosumers into energy markets, suggesting that PV companies can enhance their competitive positioning by offering personalized energy solutions. This is particularly applicable in Indonesia, where a growing segment of energy consumers could also become energy producers. Supply chain management is another critical area where competitive advantages can be secured. Menesha and Mwanaumo (2023) argue that superior supply chain capabilities can enhance responsiveness to market changes, improve product quality, and increase customer satisfaction, all of which are crucial for maintaining competitiveness in the fast-evolving PV market. Furthermore, Mursyada (2024) discusses how adopting Business Process Modeling Notation (BPMN) can improve operational efficiency, a significant competitive advantage in the PV industry, where cost efficiency and service delivery are vital. Last but not least, the research by Bouazza and Lajjam (2023) on lean manufacturing practices shows how these can improve environmental performance, an increasingly important aspect of competitive positioning in industries like PV modules, where sustainability is a significant market driver.

System Thinking in the PV Module Market

Systems thinking has emerged as a pivotal approach for addressing the complexities

inherent in the photovoltaic (PV) module market. As Hossain et al. (2020) detailed in their bibliometric analysis, systems thinking is increasingly recognized for its ability to tackle the interconnected challenges of technological and organizational contexts. This approach allows stakeholders in the PV market to consider a broader array of factors impacting the industry, from technological innovations to regulatory changes. In addition, Amissah et al. (2020) provided a synthesis of expert perspectives on systems thinking, illustrating its utility in creating holistic and sustainable solutions to complex problems. This adaptability is crucial in the PV module market, where stakeholders must navigate rapidly evolving technologies and shifting market demands. Knight et al. (2020) discuss the integration of design thinking with strategic management, which complements systems thinking by emphasizing user-centric solutions and innovation. This integration is particularly beneficial in the PV market, fostering creativity and adaptive strategies that respond to consumer needs and market opportunities.

Reynolds and Holwell (2020) introduced various systems approaches, such as System Dynamics and Soft Systems Methodology, which are instrumental in managing change and addressing uncertainty in complex environments like the PV module market. These methodologies help in understanding the dynamic interactions within the market, aiding firms in strategic planning and decision-making. Srivastava and D'Souza (2021) highlight the importance of strategic thinking in organizations, a component that is effectively enhanced by systems thinking. In the PV module market, strategic thinking helps firms recognize valuable innovations, assimilate new information, and apply it beneficially, aligning closely with the systems thinking approach. Moreover, Pembi and Ali (2024) emphasize the importance of ethical decision-making within organizations. In the PV market, systems thinking supports ethical business practices by considering the long-term impacts of decisions on stakeholders and the environment, thus fostering sustainable competitive advantages.

Olaleye et al. (2020) explored the relationship between strategic thinking and innovation performance mediated by absorptive capabilities. For the PV module market, this implies that systems thinking not only supports innovation but also enhances a firm's capacity to adapt to technological advances and integrate them into competitive strategies. In addition, Groundstroem and Juhola (2021) utilized systems thinking and causal loop diagrams to explore the impacts of climate change on bioenergy systems, a methodology that can similarly benefit the PV module market by identifying how interconnected factors influenced by environmental changes can affect production and supply. Furthermore, Saeri et al. (2019) present a causal loop diagram to analyze the long-term effects of integrating PV systems into power grids. This approach, grounded in systems thinking, is vital for PV module stakeholders to anticipate and mitigate issues arising from increased PV adoption, ensuring that economic, technical, environmental, and social considerations are balanced. Lastly, Laimon et al. (2022) advocated systems thinking to address sustainability challenges in the energy sector. This perspective is essential for the PV module market, suggesting that more comprehensive, systems-oriented approaches are necessary to achieve sustainable outcomes and ensure the industry's growth aligns with broader environmental and social goals.

RESEARCH METHOD

This study employs a qualitative research methodology to explore the competitive positioning of PT. Indonesia Solar Global within the photovoltaic module market. The qualitative approach was chosen for its strength in understanding complex phenomena from multiple stakeholder perspectives, which is essential for capturing the nuances of strategic positioning and the application of systems thinking in a dynamic industry.

Research Design

The research design for this study is illustrated in the diagram below, which provides a structured view of our methodological approach. The process begins with the establishment of research objectives, which guide the subsequent data collection phase. Data collection is divided into primary and secondary sources. Primary data are gathered through interviews and observations, ensuring a deep understanding of PT. Indonesia Solar Global's internal dynamics and external interactions. Secondary data is obtained from a thorough literature review, which helped contextualize the findings within the broader industry landscape.

After data collection, a detailed data analysis is conducted. The analysis integrates systems thinking to explore complex interactions within the data. This is achieved by identifying key variables, constructing Causal Loop Diagrams (CLDs), and interpreting these diagrams to identify leverage points that could significantly impact the system. This systematic approach to data analysis aids in developing strategic recommendations informed by both empirical data and a rigorous system thinking framework.

The flow of this process is depicted in the diagram below, which illustrates how each phase builds upon the previous to ensure a comprehensive and systematic exploration of the competitive positioning within the PV module market. This diagram serves as a visual guide to the research methodology, encapsulating the flow from objective setting to strategic recommendation, underpinned by systems thinking.

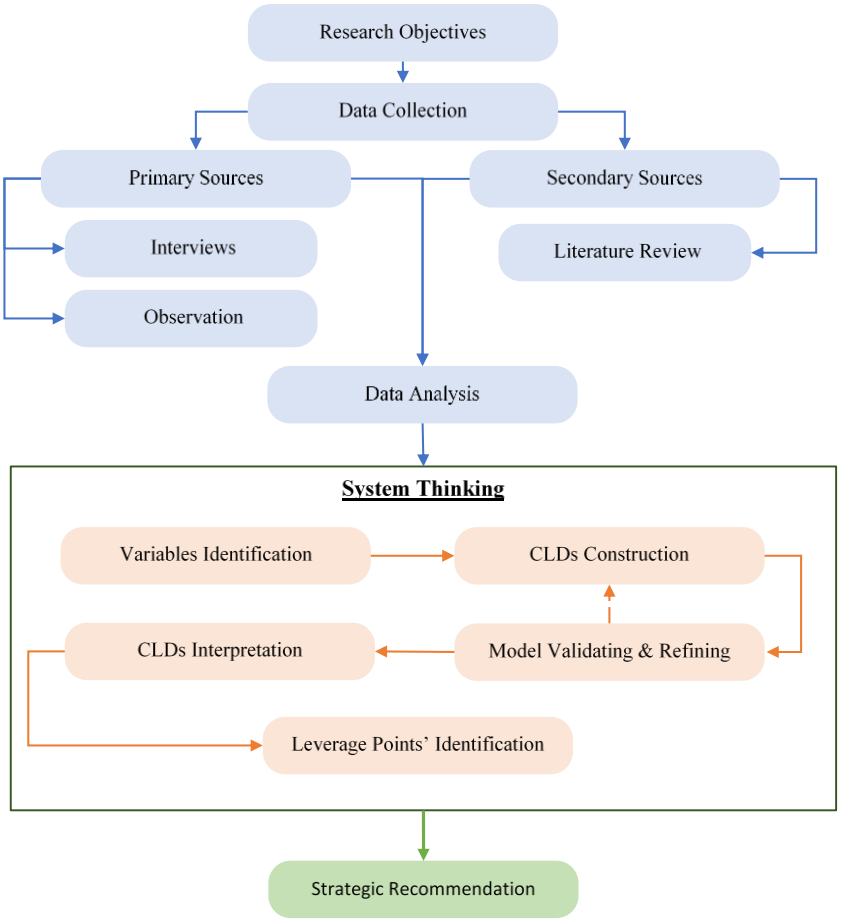

Figure 1. Research Design

Data Collection Methods

Data were collected through a combination of primary and secondary sources to ensure a holistic understanding of market dynamics and internal and external factors influencing PT. Indonesia Solar Global.

Primary data collection

Semi-structured interviews were used to collect primary data from important participants, such as the finance manager, customer representative, industry expert, government official, and managing director of PT. Indonesia Solar Global. Each participant was selected on the basis of their unique perspective and potential to contribute critical insights into market dynamics and competitive landscape. In addition to the results from the interviews, observational data were gathered within the PT. Indonesia Solar Global. These data were gathered with an emphasis on decision-making processes, daily operations, and the production process.

Secondary data collection

An extensive review of literature, industry reports, news articles, and regulatory documents was conducted to supplement the primary data. This helped contextualize the findings within the broader market and regulatory landscape, providing a comprehensive understanding of the external forces at play.

Following data collection, the information gathered from both primary and secondary sources is synthesized to form a cohesive understanding. This synthesis feeds into the analysis phase, where data are examined to derive insights into the strategic positioning within the PV module market. The flow of this data collection process is illustrated in the diagram below, detailing each step from the identification of respondents to the final analysis, ensuring clarity and systematic execution of the research methodology.

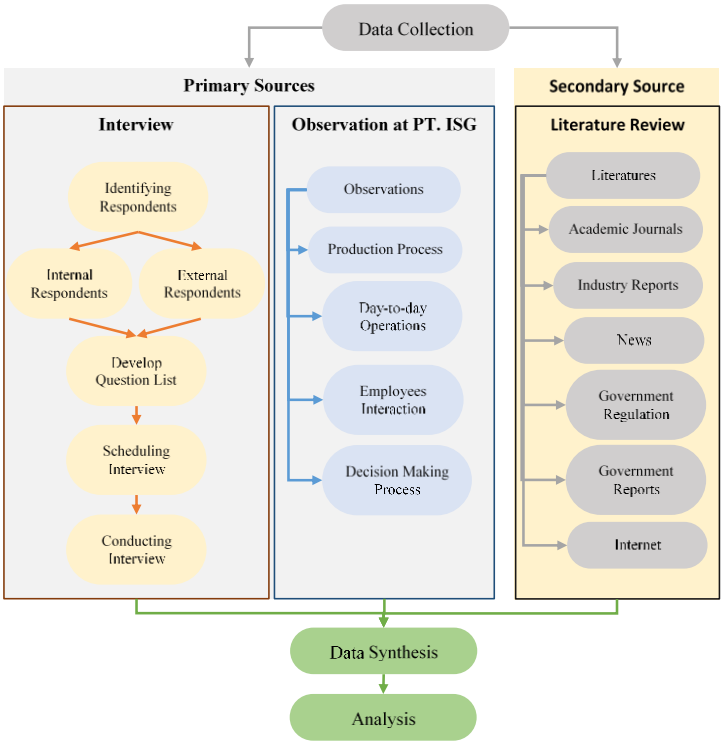

Figure 2. Data collection methods

Data Analysis Method

The core of the data analysis was to construct and interpret Causal Loop Diagrams (CLDs) to map out the systemic relationships within PT. Indonesia Solar Global's operational environment. This involved:

1. Identifying the Key Variables
   Variables influencing PT. Indonesia Solar Global's market positioning and performance were identified on the basis of the data collected.
2. Mapping Relationships Between Variables
   The relationships between these variables were mapped to determine whether they formed reinforcing (positive feedback) or balancing (negative feedback) loops.
3. Constructing CLDs
   The CLDs were constructed using Vensim software, visually representing the variables and their interconnections, thus clarifying how they collectively impact market dynamics and PT. Indonesia Solar Global's position.
4. Validating and refining the CLDs
   The initial CLDs were presented to a subset of interview participants for validation. Based on their feedback, the CLDs were refined to ensure accuracy and relevance.
5. Interpreting CLDs
   The feedback loops within the CLDs were analyzed to understand their contribution to the dynamics of the PV module market. This analysis identified leverage points where strategic interventions could significantly impact the system.
6. Applying System Insights
   The insights derived from the CLDs were directly applied to address the research question concerning competitive positioning and strategic recommendations for PT. Indonesia Solar Global.

FINDINGS AND DISCUSSION

Findings

1. Challenges and Opportunities
   The research brought to light PT. Indonesia Solar Global's main obstacle: competition from cheaper imported PV modules. Despite this, opportunities for differentiation based on quality, efficiency, and localized market strategies were identified, aligning with the findings of Gioia (2021) and Beckman (2020) regarding the importance of strategic adaptability in dynamic markets. Systems thinking has enabled ISG to identify strategic points where operational adjustments can significantly enhance competitive positioning by aligning production capabilities with market demands.

2. Causal Loop Diagram Insights
   The CLD, which was created using additional sources as well as primary data obtained from interviews and observations, revealed a number of key variables that play a crucial role in determining the competitive environment facing the company.

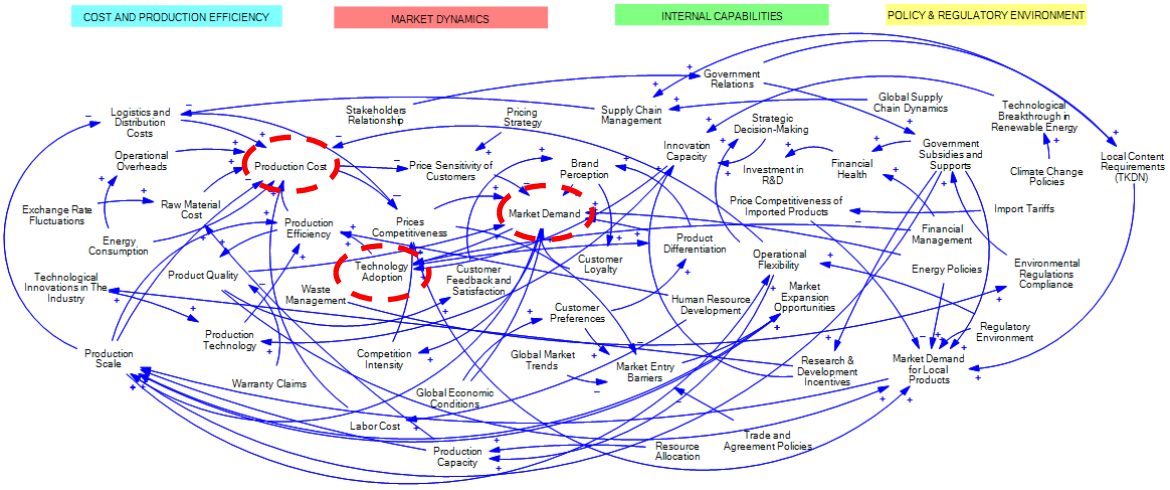

Figure 3. CLDs of the ISG market position

a. Production Cost
   This variable emerged as a cornerstone in the CLD, highlighting its direct impact on the company's ability to price its products competitively. The CLD revealed that production costs are influenced by a variety of factors, including raw material costs, operational overheads, energy consumption, and the efficiency of the production process itself. A significant insight here is the interconnectedness of production cost with other variables, such as technology adoption and production efficiency. For example, adopting advanced manufacturing technologies can reduce production costs through improved efficiencies and reduced waste, which in turn can enhance the company's price competitiveness.
b. Market Demand
   The CLD illustrated how market demand is not only a function of product pricing and quality but also of broader market dynamics such as consumer preferences, brand perception, and the regulatory environment. For instance, favorable government policies and subsidies for renewable energy can spur market demand, while advancements in PV technology can shift consumer preferences toward more innovative and efficient products. The reinforcing loop between market demand and production scale is particularly noteworthy, indicating that increased demand can lead to economies of scale, further impacting production costs and price competitiveness.
c. Technology Adoption
   Technology adoption acts as a bridge between production efficiency and market differentiation. The analysis highlighted the dual role of technology adoption in enhancing production efficiency (thereby reducing costs) and in elevating product quality and innovation. This agrees with the broader theme in the literature on the critical role of innovation in sustaining the competitive advantage in technology-driven markets. The CLD highlighted a reinforcing feedback loop where technology adoption leads to improvements in product quality, which in turn can bolster market demand and brand loyalty, encouraging further investments in technology.

The Causal Loop Diagram (CLD) developed in this study reveals critical insights into how intertwined factors such as production costs, market demand, and technology adoption influence ISG's competitive stance. For instance, the CLD illustrates that advancements in technology not only enhance production efficiency but also significantly impact product quality

and market demand. These insights highlight the application of systems thinking to decode complex market dynamics, providing a roadmap for strategic decisions that bolster ISG's market position. These variables and their interrelations highlight the balancing act between cost optimization and market expansion, resonating with Checkland and Poulter (2020) emphasis on understanding complex systems for strategic planning.

3. Feedback Loops

The ability to adapt pricing strategies in response to production scales and market demand plays a pivotal role in competitive positioning. As illustrated in Figure 4, the reinforcing feedback loop, titled "Market Demand for Local Products," demonstrates a strategic pathway crucial for ISG's market expansion and cost management strategies.

This loop starts with the increased market demand for locally produced PV modules, a response triggered by ISG's commitment to high-quality and locally relevant product offerings. As consumer preference for local products strengthens, ISG is incentivized to escalate production volumes. This increase in production, in turn, drives economies of scale, reducing overall production costs per unit. Economies of scale are a critical factor in ISG's ability to reduce selling prices without compromising profit margins, making its products more appealing to price-sensitive customers.

The reduced production costs allow ISG more flexibility in pricing strategies, which is crucial in responding to the competitive pricing pressures in the photovoltaic market. Lower prices enhance the appeal of ISG products, further boosting market demand. However, this increased demand also intensifies competition within the market. In this reinforcing loop, heightened competition is seen not only as a challenge but also as an impetus for ISG to enhance its competitive positioning through strategic price adjustments and quality improvements.

This loop exemplifies how strategic operational scaling can lead to improved market competitiveness through cost management and price sensitivity adjustments. It underlines the importance of strategic production scaling in enhancing ISG's market position, ensuring that growth in demand translates into sustainable business expansion.

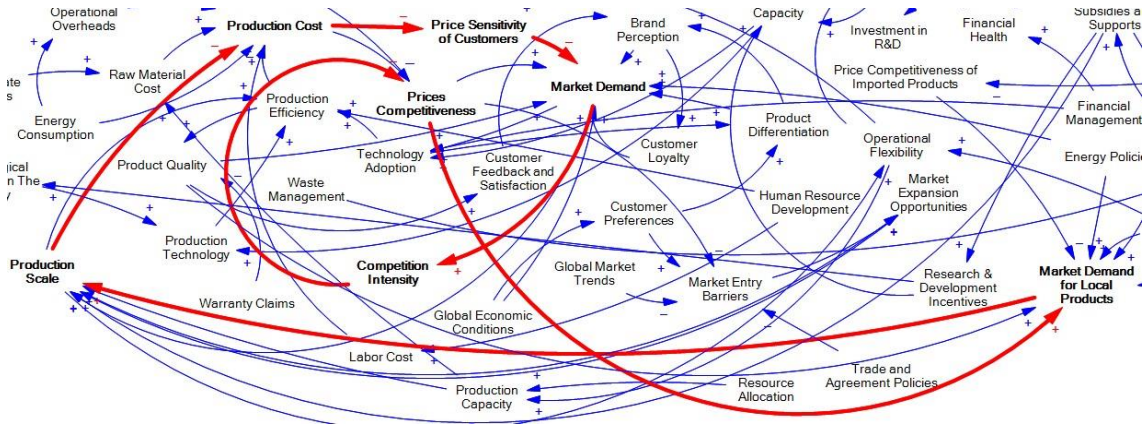

Figure 4. Market Demand for Local Products Reinforcing the Loop

The insights from this loop have significant implications for how companies like ISG can strategically manage production costs to enhance competitive advantage. By leveraging economies of scale, ISG can mitigate the risk of price wars with imported products and maintain profitability even in a highly competitive market. This strategic approach to cost management, driven by systems thinking, provides ISG with a robust framework to effectively align its operational capabilities with market demands.

Understanding and managing the dynamics of market demand and competitive pressures is crucial for maintaining a sustainable competitive edge. Figure 5 illustrates the "balancing loop," which captures the cyclical interactions between market demand, production scaling, product quality, and competitive intensity. The loop begins with the "Market Demand for Local Products," a critical driver for ISG production decisions. As local demand for ISG's PV modules increases, the company is encouraged to scale up its production. This decision is aligned with ISG's strategic goal of meeting local market needs promptly and effectively, leveraging its proximity and responsiveness to market dynamics. With the increase in production scale, ISG focuses on enhancing its production efficiency. Effective management practices are essential as they allow ISG to optimize production processes, reduce waste, and lower costs per unit. Improved production efficiency not only supports cost management but also enhances the overall quality of the products. High-quality products further stimulate market demand, reinforcing ISG's position in the market.

The improvement in product quality leads to increased satisfaction and demand among consumers, further reinforcing the cycle of demand and production. However, this increased demand also heightens competition within the market. As ISG's products gain market share, competitors may initiate price cuts or introduce new products to capture lost ground, escalating into potential price wars. Increased competition, a natural consequence of market success, exerts significant pressure on ISG's pricing strategies. If not managed carefully, this competitive intensity can lead to a downward spiral of price cutting, which might erode profit margins and undermine long-term sustainability. The balancing loop reflects this tension, showing how essential it is for ISG to maintain a balance between expanding market share and effectively managing competitive responses.

This balancing loop is a manifestation of systems thinking applied within the context of the ISG's operational strategy. It illustrates how interconnected elements within a business ecosystem can impact one another and emphasizes the need for strategic oversight to maintain balance. Systems thinking enables ISG to foresee the potential outcomes of increased production and market demand, guiding the company to implement strategies that mitigate the risks associated with intensified competition.

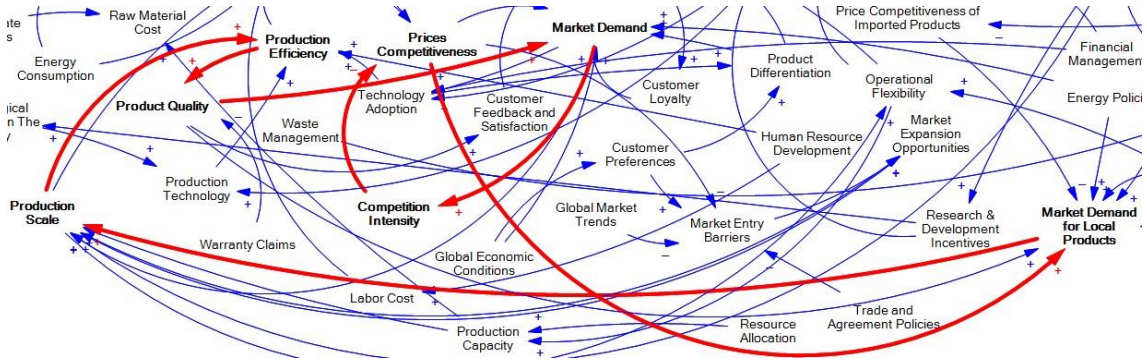

Figure 5. Market Demand for the Local Products Balancing Loop

The analysis of the balancing loop provides a vivid illustration of the PT. Indonesia Solar Global (ISG) strategically manages its production and market responses to maintain a strong competitive position within the photovoltaic module market. This approach showcases the company's adeptness in enhancing product quality and scaling production in response to fluctuating market demands. Such strategic management underscores the practical application of systems thinking; it elucidates how ISG navigates the complex interdependencies of market dynamics, competitive pressures, and operational efficiencies. By employing systems thinking,

ISG not only anticipates potential challenges but also develops proactive strategies that bolster its market stance, ensuring that each decision aligns with broader business objectives and market conditions. This comprehensive approach highlights the interconnected nature of competitive positioning, market challenges, and strategic insights derived from systems thinking, offering valuable lessons for industry players on sustaining competitiveness in dynamic markets. The balancing nature of this loop serves as a cautionary tale, reiterating the significance of preserving equilibrium in complex systems, as highlighted by (Loaiza & Cloutier, 2022).

4. Market Demand Causes the Tree

Figure 6 illustrates the complex web of factors that influence the market demand for locally produced PV module products. Central to this analysis are the roles of government policies and energy regulations, which directly impact the affordability and attractiveness of local PV modules through subsidies and local content requirements. In addition, production costs and efficiency play critical roles in shaping price competitiveness and product quality, further driving market demand. This diagram underscores the interplay between regulatory frameworks, operational efficiencies, and competitive strategies, highlighting how each element contributes to strengthening the market presence of locally produced modules in a competitive landscape.

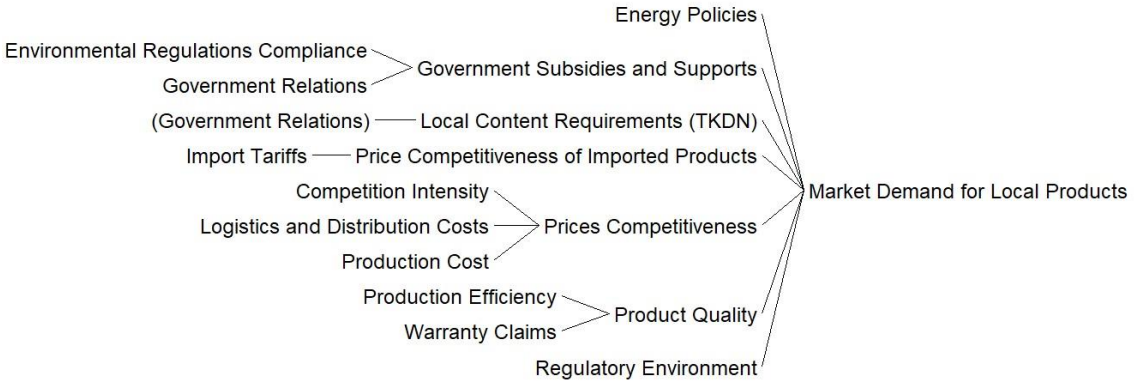

Figure 6. Market Demand for Local Products Causes Tree

Figure 7 maps out the diverse factors that collectively influence global market demand for PV modules. Key elements include customer feedback and satisfaction, which enhance brand perception and foster customer loyalty—critical drivers in a market where reputation significantly impacts consumer choices. Economic conditions and energy policies also play substantial roles in influencing the affordability and attractiveness of PV products. In addition, the diagram highlights how competitive strategies, such as pricing and product differentiation, interact with production efficiencies and technology adoption to determine product quality and market competitiveness. This causal tree illustrates how multiple external and operational factors converge to shape market demand, providing PT. Indonesia Solar Global provides strategic insights into navigating global market dynamics effectively.

Figure 7. Global Market Demand Causes Tree

This analysis provides a granular view of the factors driving market demand, from regulatory impacts to brand perception, underscoring the multifaceted nature of market dynamics, as discussed by Taylor et al. (2020).

Discussion

In comparison to previous research, the results of PT. Indonesia Solar Global's market position and the use of systems thinking offer a unique contribution. While scholars like Beckman (2020) and Checkland and Poulter (2020) have previously articulated the abstract value of systems thinking as a methodology for understanding and addressing complexity in business environments, this study takes a step further by applying systems thinking concretely to the PV industry's specific challenge of price competition with imported products. Beckman (2020) discusses the conceptual underpinnings of framing problems in design thinking, which resonates with the systems thinking approach in its emphasis on holistic understanding. However, this study bridges the gap between theory and practice by demonstrating how systems thinking can lead to tangible competitive strategies. For instance, the study extends Beckman's theoretical exploration into practical application by using causal loop diagrams to identify leverage points within PT. Indonesia Solar Global's operational and strategic framework. Similarly, Checkland and Poulter (2020) advocate for the soft systems methodology as a means to tackle ill-structured problems. They propose that understanding the complex interrelations in organizational settings can lead to actionable interventions. This research complements their theory by applying systems thinking to the structured analysis of PT. Indonesia Solar Global's competitive environment, offering a pragmatic illustration of how systemic interventions can address industry-specific challenges such as the impact of imports on local market dynamics.

By grounding systems thinking in the real-world context of PT. In Indonesia Solar Global, this study not only reaffirms the methodological value proposed by existing literature but also enhances it by showcasing its applicability in strategic decision-making aimed at improving competitive positioning. This application is significant in demonstrating how a theoretical approach like systems thinking can yield practical, strategic insights that directly inform business decisions and lead to improved market performance, particularly in industries facing the nuanced challenge of competing against global imports.

Strategic implications derived from the identified feedback loops and market demand

drivers in PT. Indonesia Solar Global's analysis underscores the necessity for a comprehensive strategy that encompasses cost optimization, quality enhancement, and market expansion. This multifaceted strategy is a change from conventional approaches that primarily concentrate on obtaining cost competitiveness through cost leadership or economies of scale. Instead, it acknowledges the complex and interconnected nature of factors that drive market demand and the competitive advantage in the PV sector.

Cost Optimization

The feedback loops within the causal loop diagram (CLD) highlight the importance of maintaining a cost structure that allows PT. Indonesia Solar Global to compete effectively with imported modules. This goes beyond simple cost-cutting measures, prompting the company to consider strategic cost management, which includes streamlining operations, improving production efficiency, and optimizing supply chain logistics. Such an approach ensures that cost reduction does not compromise product quality or market responsiveness.

Quality Enhancement

The analysis reveals that product quality is a critical determinant of brand perception and customer loyalty, which in turn drives market demand. By focusing on quality, PT. Indonesia Solar Global can differentiate its products from lower-cost imports and potentially justify a premium price. Enhancing quality involves continuous improvement in production processes, investment in technology, and adherence to high-quality standards, leading to a better value proposition for customers.

Market Expansion

The study's insights into market demand drivers show the need for diversification of the company's market base. Expanding into new markets or segments can reduce the company's reliance on traditional markets and government projects. It involves identifying untapped or underserved customer segments, understanding their specific needs, and tailoring products to meet those needs. Additionally, exploring international markets can open up new revenue streams and reduce the risk associated with dependence on the local market.

Business Solution

The suggested business solutions for PT. Indonesia Solar Global is a calculated combination of projects meant to tackle complex issues and take advantage of opportunities identified through systems thinking analysis. The solutions cover a wide range of strategic initiatives, each selected for its potential influence on the competitive standing of the company in the photovoltaic market.

1. Cost Reduction Initiatives

   A core component of the proposed solutions is a suite of cost reduction initiatives. These include the implementation of lean manufacturing practices, negotiation of bulk purchasing agreements, and investment in automation and technology. Each initiative is designed to streamline operations, reduce waste, and ultimately lower production costs—essential for competing in a market with high price sensitivity. The systems thinking analysis recognized the interconnections between production efficiency, cost structures, and market pricing dynamics, leading to targeted activities that can positively influence these variables.

2. Product Differentiation Strategies
   Differentiation is critical in markets where competing on price alone is unsustainable. Thus, the proposed solutions call for establishing partnerships for technology exchange and implementing certified quality control measures. These strategies aim to elevate the uniqueness and quality of PT. Indonesia Solar Global's products, distinguishing them from competitors, particularly imports that compete mainly on price. This aligns with the systems analysis that highlights the importance of quality and brand perception as drivers of customer loyalty and market demand.

3. Market Expansion Plans
   Recognizing the need to diversify market reliance, the strategic plan includes identifying new market segments and developing targeted marketing strategies. By expanding into new geographical or sectoral markets. Indonesia Solar Global can reduce its dependency on current market conditions and government projects, thus increasing its resilience to market fluctuations. This aspect of the solution set taps into the systems thinking insight that a diversified market approach can buffer a company against the risks associated with a narrow customer base.

4. Strategic Alliances and Collaborations
   To leverage external expertise and access new markets, the company is encouraged to establish strategic alliances and engage in joint ventures. Such collaborations can provide the company with critical market intelligence, technological capabilities, and entry into markets that would be challenging to penetrate independently. The system analysis underlines the value of such partnerships in creating synergistic relationships that can enhance innovation and market reach.

5. Government Engagement and Policy Advocacy
   Lastly, the solutions emphasize the importance of engaging with government bodies and participating in policy development. This proactive stance in policy dialog ensures that the company's interests are represented and can influence the regulatory environment in which it operates. The systems thinking analysis elucidates the significant role that government policies and subsidies play in shaping market opportunities for renewable energy products.

The findings demonstrate the novel application of systems thinking to improve competitive positioning within the photovoltaic industry, offering actionable insights through detailed analysis of PT. Indonesia Solar Global (ISG). Unlike prior works, this research provides a practical framework that integrates systems thinking directly into strategic and operational planning, showcasing how companies can leverage this approach to effectively navigate complex market dynamics. Theoretically, this research advances the application of systems thinking in strategic management, particularly within technology-driven markets. It illustrates how understanding complex interdependencies through systems thinking can enhance competitive strategies and operational efficiencies.

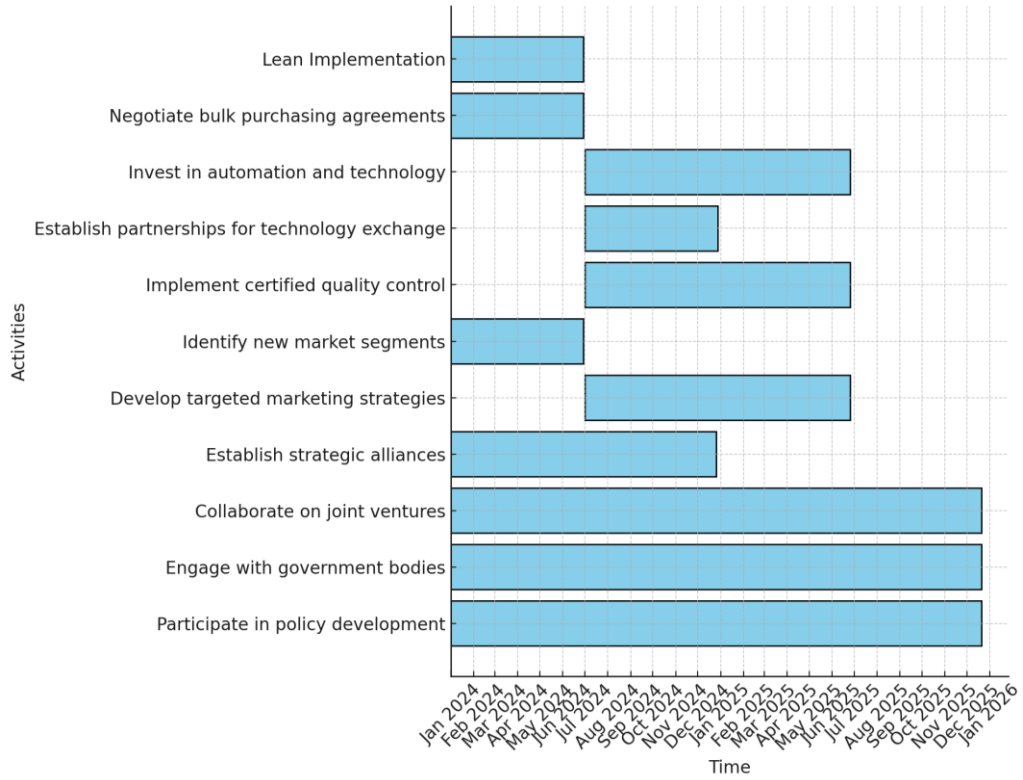

Figure 8. Proposed Business Solution for the PT. ISG

CONCLUSIONS

This study explored strategic interventions for PT. Indonesia Solar Global (ISG) within the photovoltaic module market, employing systems thinking to understand and enhance its competitive positioning. The research addressed key questions regarding the application of systems thinking to dissect competitive dynamics and identify strategic interventions necessary for ISG to effectively leverage its market position.

Key findings

1. Systems thinking provided a holistic view of ISG's operational and market challenges, highlighting the interplay among production costs, technology adoption, market demand, and regulatory influences.
2. The recommended strategies include optimizing production efficiency, diversifying product lines, and advocating for supportive renewable energy policies. These interventions improve ISG's cost competitiveness and market responsiveness.

Practical Implications

1. Management**:** Focus on enhancing production efficiency and quality, exploring strategic partnerships, and adopting flexible pricing strategies.
2. For Policymakers**:** Enhance support for renewable energies through subsidies, adjust local content requirements, and streamline regulatory processes.

This study demonstrates the practical application of systems thinking in strategic management within the PV market, providing a framework that enhances the understanding of complex industry dynamics and guides strategic decision-making. This research offers both theoretical insights and

actionable strategies for firms navigating similar competitive landscapes. In summary, the findings from this study not only advance the understanding of systems thinking in a practical setting but also provide actionable guidance for improving competitive positioning in the rapidly evolving photovoltaic module market.

LIMITATION & FURTHER RESEARCH

This study's primary limitation is its reliance on data from a singular company within Indonesia's PV market, which may not reflect wider industry trends. Moreover, the qualitative nature of the research and the static timeframe limit the generalizability and temporal applicability of the findings. The causal loop diagrams used in the systems thinking approach also inherently simplify complex market dynamics and lack quantitative validation.

Future studies could explore how systems thinking can be applied to other aspects of the photovoltaic industry, such as supply chain management, customer relationship management, and sustainability practices. Each of these areas features complex interactions that could benefit from the holistic insights provided by systems thinking.

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