EasyChair Preprint

№ 13969

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July 15, 2024

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Abstract. This study explores the operations strategies of an electricity distribution company, focusing on the effectiveness and efficiency of these practices. Energy distribution is a crucial pillar in any country's infrastructure, directly influencing economic development and social welfare. The research uses a qualitative and exploratory approach, including a detailed case study in an energy company. The article highlights the importance of innovation and adaptation in a highly regulated and technically complex sector. The effective implementation of operations strategies responds to the growing demands of maintenance and operation, ensuring reliability and sustainability in energy supply. The study reveals that the alignment between theory and practice is crucial to the success of operational strategies, reflecting a balance between academic knowledge and the practical demands of the sector.

Keywords: Operations Strategies, Electricity Distribution, Operational Efficiency, Electricity Resource Management, Sustainability in Electricity Supply.

1 Introduction

Electricity distribution, an essential service, imposes on distributors the obligation to ensure that all residential or commercial consumers are connected to the electricity grid. This includes responsibility for the operation and maintenance of the distribution system, which makes it imperative to develop new strategies [9].

In the contemporary scenario of the electricity industry, facing and overcoming operational and strategic challenges is fundamental to ensuring the delivery of efficient and reliable services. Understanding operational strategies in this sector is therefore crucial for the academic community, industry professionals, and policymakers.

The research highlights the importance of adapting to an environment marked by strict regulations and considerable technical challenges, where effective operational strategies are vital to meet the growing demands of maintenance and management while ensuring reliability and sustainability in energy supply.

2 Literature review

This section outlines the theoretical basis of the research, emphasizing the fundamental definitions of the topics discussed, the relevant information, and the most important aspects that underpin the analysis of operational strategy in an electricity distribution company.

2.1 Operations strategy

Strategy, originally linked to war and adapted to the business world to set goals and draw up long-term plans, faces challenges such as the misalignment of objectives and market instabilities, leading to the formation of more organic strategies than traditional models suggest. Day-to-day decisions, especially in production, can restrict strategic options by tying the company to long-term policies, and top management often delegates critical decisions to lower levels, creating a mismatch with larger strategic objectives. Operations Strategy, evolving since Skinner, encompasses manufacturing, production, and service management, focusing on helping companies achieve competitive objectives by adapting production to various strategies. This approach allows each company to define its 'competitive priorities,' such as quality or profit, according to its strategies and market context, without a standard model of priorities. Overcoming manufacturing challenges goes beyond the pursuit of productivity and efficiency, requiring the direct participation of top management in formulating and integrating manufacturing policies with the company's overall strategy and recognizing and managing trade-offs in designing production systems to meet specific business needs. The debate on manufacturing strategy presents two views: one advocates the need for difficult choices due to limitations, while the other proposes adopting best practices to achieve excellence in multiple competitive areas without compromises. In diverse industrial environments, a management approach that aligns manufacturing with competitive strategy and market conditions is crucial, emphasizing the importance of clear objectives and promoting operational and cost efficiency. This approach directs production units towards a common goal, increasing internal synergy and strengthening the company's competitive position in the market [13] [15] [16] [19] [20] [22].

2.2 Operations-Based Strategy

Operations strategy, distinct from day-to-day operational management, focuses on long-term planning and direction for the organization's broader objectives, while operational management concentrates on day-to-day tasks. This strategy elevates operations analysis by considering internal interactions and the company's position in its network of suppliers and partners, aligning operations with the company's strategic objectives using the 'input-transformation-output' model. Crucial for creating and delivering products and services, the operations function interacts with marketing, product/service development, and support functions, broadening its scope to integrate marketing strategies and people management and emphasizing overcoming functional barriers for a collaborative environment. Additionally, manufacturing, central to many companies, demands a transformation of entrenched practices into competitive advantages,

requiring a detailed understanding of its role in market success. Strategic planning and the effective implementation of strategies in day-to-day activities are essential for business success, necessitating rapid adaptation to changes. Thus, operational strategy integrates the corporate vision with practical adjustments, sustaining a lasting competitive position. Critical decisions about production capacity, process integration, and people management in manufacturing often mix elements at various stages of development, with the balance between these elements determining a company's operational maturity and positioning on a development spectrum. To achieve success, companies need a strategic vision to guide their actions, developing guidelines to shape choices and behaviors in line with performance objectives. The operations strategy, although complex, acts as a beacon for conscious decision-making. How companies manage their operations can create a competitive advantage that is difficult to replicate, allowing them to maintain a prominent market position. This operational efficiency, often subtle, provides a discreet but valuable advantage that competitors can ignore, consolidating the company's leadership position. [11] [12] [21] [22].

2.3 Resource-based strategy

When building long-term business strategies, it is essential to focus on internal resources and capabilities, which drive the strategy and are crucial for profit while adapting to changes in customer preferences and technological advances. An effective strategy based on these internal capabilities ensures stability and the ability to adapt to market challenges, where efficient management of these resources, including operational efficiency and innovation, leads to success and competitive advantage. Often underestimated, resource management faces challenges such as assessing the opportunity cost of rare assets and maximizing productivity. It requires a detailed examination of the relationship between resources and organizational capabilities to promote sustainable growth and profitability. In addition, distinct resources and organizational capabilities developed through complex coordination are essential for maintaining a lasting competitive advantage. This highlights the importance of strategies that take advantage of opportunities and mitigate threats, reinforcing the interaction between environmental analysis and resource-based models [3] [5] [10].

2.4 Sustainable operations

Sustainability has become an essential aspect of supply chains, extending the focus of operational management beyond the pursuit of profit by incorporating considerations of social welfare and environmental protection. Contemporary companies are implementing sustainable practices, such as reducing carbon emissions and minimizing waste, aiming not only at operational efficiency but also at balancing the expectations of all stakeholders—including shareholders, employees, and the community—to improve performance in financial, environmental, social, and governance (ESG) terms. The challenge lies in reconciling ecological initiatives with financial advantages and encouraging innovations that align sustainability goals with economic growth. To excel in sustainability and financial performance, companies need to innovate in products, processes, and business models, focusing on significant improvements in key ESG

areas and beyond mere modifications to fully transform their competitiveness and performance. Integrating sustainability into operations requires far-reaching strategic decisions and a preventive approach, rooting these objectives in the organizational culture to balance sustainability with other decision-making criteria. This suggests a unified management system that encompasses quality, health, safety, and sustainability, to optimize efficiency and transparency [4] [7] [14].

2.5 Regulatory aspects of electricity distribution

The regulatory guidelines for energy distributors emphasize the need to offer consistent, efficient, safe, and affordable services, stressing the importance of serving all users in an up-to-date and inclusive manner. The regulatory body imposes criteria to guarantee the maintenance of service quality, requiring modern techniques and equipment, as well as the continuous conservation, improvement, and expansion of services. This process includes investments in new technologies to optimize service provision, reduce operating costs, and improve service efficiency. The concessionaires are responsible for ensuring the continuity and adequacy of services, prioritizing efficiency, minimizing energy losses, controlling costs, and bringing their quality indicators and interruption rates to regulatory standards. To assess service continuity, indicators measure the duration and frequency of supply interruptions, considering individual and collective assessments, including specifics for public lighting, to ensure an effective and inclusive service for all users [1] [2].

2.6 Protection, control, and supervision system

Intelligent Electronic Devices (IED) and circuit breakers are fundamental components in electrical systems, responsible for detecting faults and irregularities, guaranteeing safety and continuity of service by minimizing damage to equipment, and preventing risks to personal safety. Connected to the system via current and potential transformers, IEDs act in coordination with circuit breakers to control and limit the effects of short circuits, maintaining the integrity and efficiency of the system. While the IED monitors variables such as current and voltage, triggering the circuit breakers to interrupt abnormal currents, the circuit breakers, in turn, are designed to interrupt these currents safely and effectively, both under abnormal conditions and in regular operation. The ability to perform complex protection actions in fractions of a second is vital, with circuit breakers prepared to withstand harsh environments and long periods of inactivity, ensuring fault readiness and contributing to a reliable and safe electrical system [6] [17].

The philosophy behind applying IED in electrical systems aims to effectively segment the network into various protection zones to ensure maximum safety with minimum equipment interruptions in the event of faults. This strategy involves implementing primary protections in each zone, complemented by additional local and adjacent area safety systems, for comprehensive fault coverage. Coordinating protection devices, such as IEDs and fuses, is essential to calibrate their response times and avoid large-scale power cuts, allowing some devices to react more quickly than others during faults, minimizing interruptions, and ensuring the continuity of the power supply. In addition,

the use of SCADA systems is fundamental for the efficient management of electrical networks, providing a platform for analyzing the data provided by IED, which supports the monitoring, control, and automation of the electrical system, helping to reduce operating costs and facilitating decisions based on real-time information to optimize system performance [6] [8].

3 Methodology

This study adopts a qualitative and exploratory approach, emphasizing a case study of an electricity distribution company. This company was chosen due to the author's direct involvement in its operational management process. The focus of the study is to investigate the operational strategies adopted by this company, with particular attention to the interaction between theory and practice in daily operations.

The case study method stands out in research because it allows for a detailed exploration of individual entities, such as people, families, groups, or communities, to understand various aspects of their experiences regarding a specific topic. It applies to both qualitative and quantitative approaches. It requires rigor, clarity of purpose, innovation, and consistency to be effective. In addition, qualitative research focuses on the dynamic interaction between the subject and their environment. It values subjective experience and the interpretation of meanings without relying on statistical techniques, favoring naturally collected data and inductive analysis. At the same time, exploratory research serves as an initial step to deepen the understanding of a topic. It helps to clarify the subject, define objectives, and formulate hypotheses, characterized by its flexibility and use of methods such as literature review, interviews, and analysis of relevant cases. This approach opens new research perspectives [18].

This study stands out for its methodology, which combines the detailed analysis of a specific case with the direct experience of the author, who works as a coordinator in the company analyzed. This position allowed close observation of internal dynamics and strategic decisions, capturing nuances that traditional approaches might overlook. Data collection was enriched by the author's active participation in the company's day-to-day and strategic activities and his involvement with various hierarchical levels, which provided access to valuable information and insights. The analysis adopted an iterative process, comparing observations with academic literature, allowing for the description and evaluation of the effectiveness of operational strategies within the context of electricity management. However, it is essential to recognize the limitations, such as the potential subjective bias and the caution required in generalizing the results. Despite this, the unique perspective offered by the author's direct experience adds a dimension of richness and depth to the analysis that compensates for these limitations.

4 Case studies

Within the electricity utility, the Operation and Maintenance Department is divided into substation operation and maintenance, where operation requires in-house maintenance services. This maintenance is bifurcated into electromechanical, focused on physical substation equipment, and protection, control, and supervision systems essential for the safety and efficiency of the electricity system. This arrangement highlights the interconnection between maintaining the infrastructure and ensuring the operability and protection of the electricity supply (see **Erro! Fonte de referência não encontrada.**).

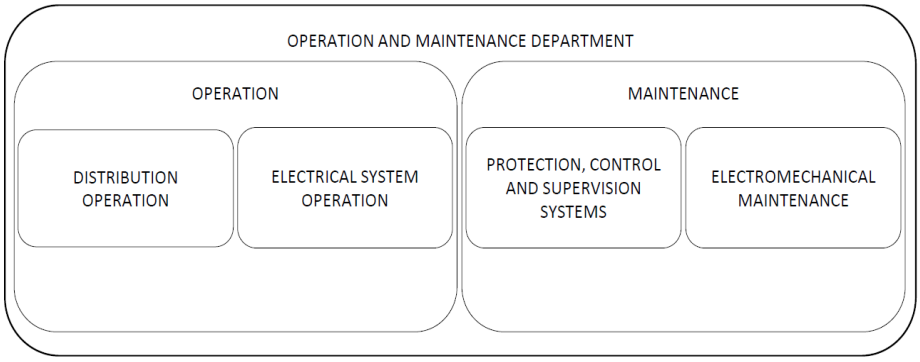

Fig. 1. Previous configuration.

The Operation and Maintenance Department configuration needed to meet the real needs adequately. The division between the substation operation and maintenance processes is needed to prioritize the demands correctly. The operation identifies the needs and opens service orders; however, there are various requests to be addressed, and the substation maintenance is responsible for handling them. Some requests are considered a priority by the operation, especially those resulting from events in the electrical system, which can cause the undue opening of equipment and unnecessarily interrupt the power supply to many consumers.

Improper interruptions cause problems in the continuity indicators of the utility company, as the inappropriate shutdown of a transmission line can disrupt the power supply to various customers. These consequences may result in the need to pay compensations on the consumer's bill for exceeding the indices defined by the regulatory agency, as well as causing a loss of revenue for the company during the service interruption period.

The observability of events in the power system enables quicker and more effective decision-making. Thus, equipment that is not functioning correctly or lacks remote supervision complicates the analysis of occurrences and the identification of abnormalities, in addition to increasing operational costs related to labor time and travel.
To meet the demands of the operation and optimize the protection and selectivity of substation and transmission line equipment, the Coordination of Protection, Control, and Automation was created. This coordination arose from the need to improve the

maintenance of the electrical system's protection, control, and supervision systems, incorporating an electrical engineer into the operation to strengthen collaboration between teams. The initiative aims to enhance the efficiency and alignment of activities, prioritizing critical tasks to raise maintenance standards, anticipate risks, and enhance the resilience of the electrical system, promoting a more reliable and sustainable operation (see Fig. 2).

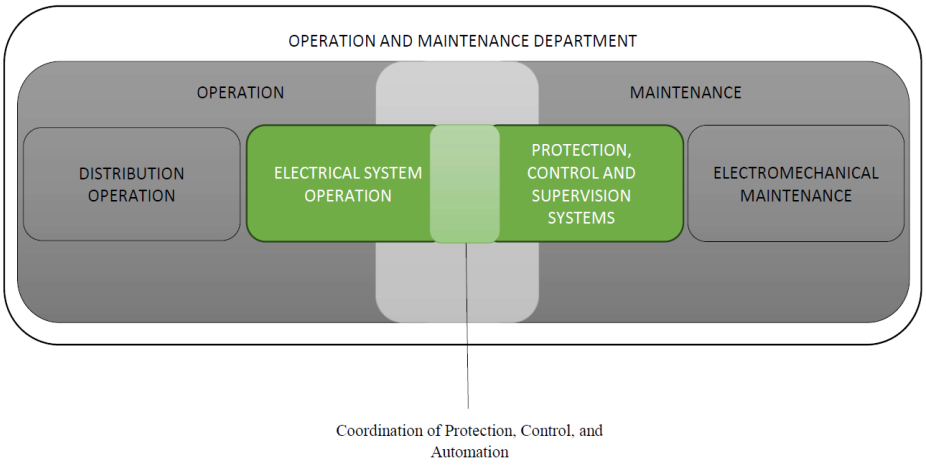

Fig. 2. New configuration.

In the quest to optimize the management of the electricity system and face complex operational challenges, the electricity utility has implemented significant strategies to improve the maintenance and efficiency of the protection, control, and supervision systems. These challenges, which range from meeting the requests of the National Electricity System Operator to ensuring operational reliability and the search for continuous improvements, have required a strategic approach focused on integration and effectiveness. To this end, the Coordination of Protection, Control, and Automation was established, an initiative designed to foster collaboration between the operations and maintenance teams, ensuring that maintenance demands emerge in a way that is more aligned with the operational needs of the electricity system. This new structure set out to provide more efficient execution of activities, prioritizing actions according to their importance and relevance to the system.

Among the main actions undertaken were changes to the Regional Load Relief Scheme and the replacement of Intelligent Electronic Devices (IEDs) in several strategically located substations. These actions were planned based on operational strategies, available resources, and sustainability.

Modification of the Regional Load Relief Scheme: The modification of the ERAC was a critical measure to maintain the balance between load and generation, avoiding a complete system shutdown. With five stages of intervention, the new scheme allowed

for a load cut of up to 55%, significantly improving compared to the previous scheme, which cut up to 40%. After identifying insufficient equipment, the team evaluated the relays with the under-frequency function and developed a plan to use spare and existing relays in refurbished substations. Effective implementation increased the capacity to respond to frequency drops, ensuring system reliability and sustainability.

Replacement of Relay at Line Terminal 60 km from Headquarters: After incidents of improper relay operation that caused unintentional interruptions, the team identified the need to replace damaged relays. Performance analysis and the search for substitutes resulted in specifying and installing suitable relays, improving protection, and reducing impacts on continuity indicators.

Replacement of Relay at Line Terminal 262 km from Headquarters: With the deactivation of a power plant, it became necessary to replace relays to ensure remote monitoring and electrical supervision in the region. It installed new relays that allowed for collecting oscillography records and remote voltage control, reducing operational costs and improving sustainability.

Replacement of Relay at Line Terminal 323 km from Headquarters: The need to monitor an unsupervised terminal led to replacing relays using a model compatible with other distant substations. The strategy focused on sustainability, reducing time and travel costs, and improving operational visibility and control.

Automation of Forced Ventilation System in Power Transformer 323 km from Headquarters: Due to temperature-related shutdown problems, it was necessary to automate the transformer's forced ventilation. Verifying and installing a compatible controller enabled automatic operation, ensuring equipment reliability and avoiding unwanted load shedding.

These initiatives, carefully planned and executed, reflect a commitment to continuous improvement in the operation and maintenance of the electrical system. The successful implementation of these strategies has met operational and regulatory demands, established more sustainable practices, reduced costs, and minimized environmental impacts. In the long term, these actions contribute significantly to the resilience and sustainability of the electrical system, ensuring more reliable operation. This case illustrates the importance of integrated strategic management, considering both the immediate and future needs of the electrical system and reinforcing the relevance of operational and technological innovations in the energy sector.

5 Conclusion

This study offers significant insights into operational strategies in an electricity distribution company, highlighting the fusion between theory and practice and emphasizing the need for innovation and adaptation in a highly regulated and complex environment. The adopted methodology was qualitative and exploratory, based on a detailed case

study and complemented by the author's direct experience, which allowed for an in-depth understanding of the operational and strategic dynamics of the company.

The main conclusions of the study are:

Implementation of Effective Operational Strategies: The company demonstrated the ability to implement effective operational strategies by aligning maintenance and operational practices with the emerging needs of the electrical system. This alignment was crucial to ensuring the reliability and sustainability of the energy supply.

Integration of Theory and Practice: The study revealed that integrating theory and practice in operational strategies is fundamental to success in the electricity distribution sector. The strategic decisions made by the company reflected a balance between theoretical knowledge and the practical demands of the operational environment.

Challenges and Innovations: The company faced significant challenges, such as the need to adapt to stringent regulations and the technical complexity of the sector. However, through innovation and a focused strategic approach, it overcame these challenges and continuously improved its operations.

Implications for the Sector: The findings of this study have a practical impact on the electricity distribution sector, suggesting that other companies may benefit from adopting similar operational strategies, particularly concerning integrating theory and practice and focusing on innovation.

Recommendations and Future Research: It is recommended that future research focus on exploring different approaches to operational strategies in other companies within the sector further to enrich the understanding of effective practices in various contexts. Additionally, further studies could examine the impact of technological and regulatory changes in the sector.

In summary, this study contributes to the existing literature by offering an in-depth understanding of operational strategies in an electricity distribution company, emphasizing the importance of innovation, adaptation, and the integration of theory and practice in daily operations.

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