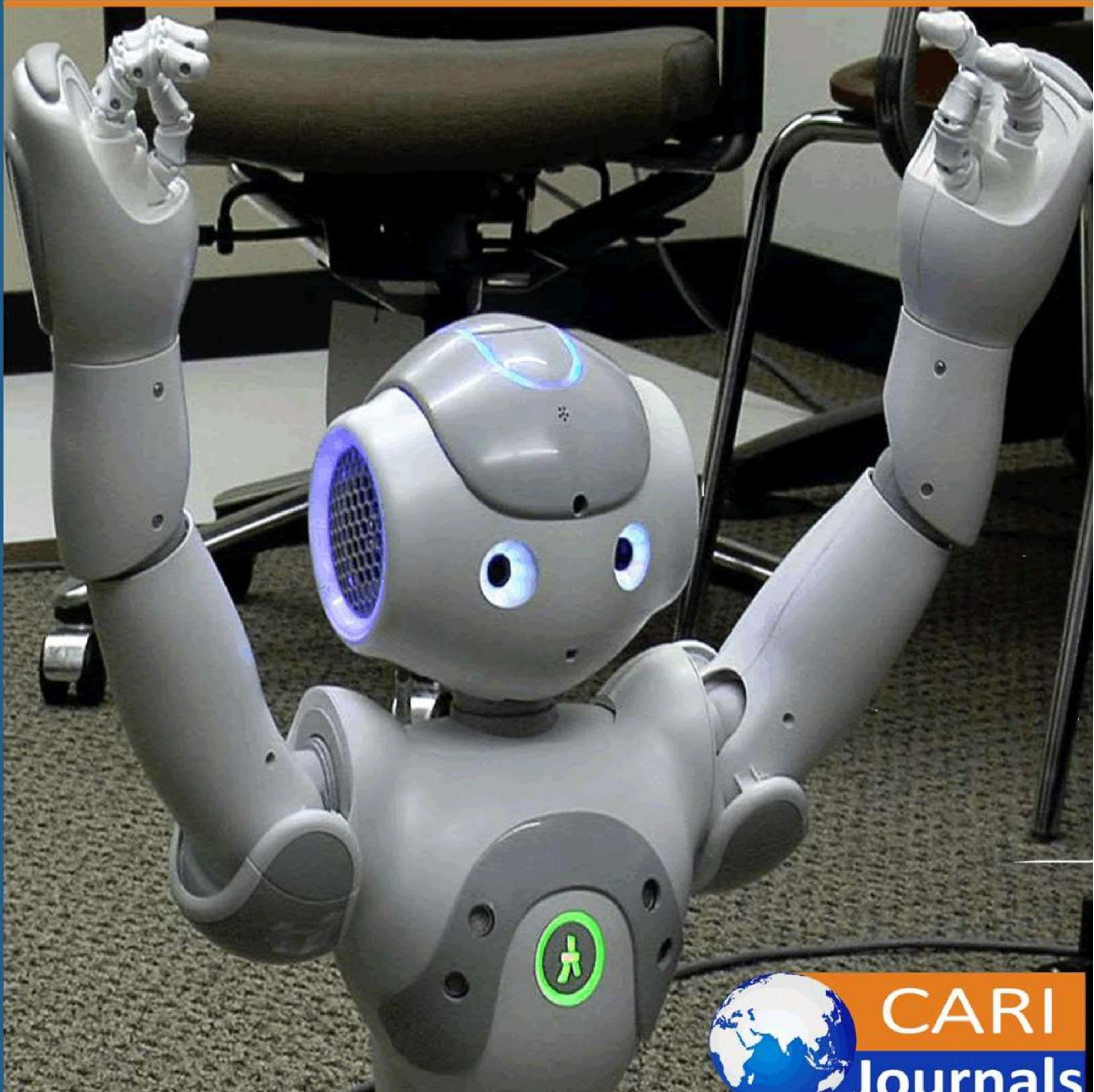
International Journal of
Computing and Engineering
(IJCE)

Relationship between Cloud Computing Resource Allocation Algorithms and Energy Efficiency in Data Centers in China



Relationship between Cloud Computing Resource Allocation Algorithms and Energy Efficiency in Data Centers in China

Huang Yue

Fudan University

Abstract

Purpose: The purpose of this article was to analyze the relationship between cloud computing resource allocation algorithms and energy efficiency in data centers in China.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: China show that advanced cloud resource allocation algorithms like Ant Colony Optimization and Genetic Algorithms improve data center energy efficiency by 20–35%. Integrating predictive models further reduces power use and cooling needs. However, adoption is limited by high costs and security concerns.

Unique Contribution to Theory, Practice and Policy: The resource-based view (RBV), the green it adoption theory & the complex adaptive systems theory may be used to anchor future studies on relationship between cloud computing resource allocation algorithms and energy efficiency in data centers in China. Researchers and practitioners should implement pilot projects in operational cloud data centers to collect longitudinal performance data on energy savings, workload handling, and potential trade-offs (e.g., latency, migration overhead). Policymakers should consider financial incentives, green certifications, and regulatory frameworks that encourage investment in energy-aware scheduling technologies.

Keywords*:* *Cloud Computing Resource Allocation Algorithms, Energy Efficiency, Data Centers*

International Journal of Computing and Engineering
ISSN 2958-7425 (online)
Vol. 4, Issue No. 3, pp. 42 - 52, 2023 www.carijournals.org

INTRODUCTION

Energy consumption, measured in kilowatt-hours (kWh), quantifies the total electricity used by residential, commercial, and industrial sectors over a given time. In the United States, total electricity consumption reached approximately 4,178 billion kWh in 2022, driven primarily by data centers and electrification of transport (EIA, 2023). Japan's energy consumption was about 981 billion kWh in 2021, reflecting a gradual decline due to efficiency measures and demographic changes (IEA, 2022). Over the last decade, developed economies have shown a trend toward stabilizing or reducing per capita electricity use, despite economic growth, through smart grid technologies and efficiency regulations. These patterns highlight a decoupling of energy consumption from GDP growth in advanced economies (Zhu, 2020).

For example, the United Kingdom has reduced electricity consumption from 357 billion kWh in 2010 to 300 billion kWh in 2022, driven by the adoption of renewable energy sources and improved building standards (UK BEIS, 2023). In the USA, the growth of cloud computing increased industrial consumption by nearly 6% between 2017 and 2022, although residential demand remained stable. Japan's energy consumption per capita fell from 7,900 kWh/year in 2010 to about 7,100 kWh/year in 2021. This reflects the success of efficiency policies and a shift away from fossil fuel-based power generation. These trends suggest that advanced economies can achieve energy reductions without compromising productivity (Zhu, 2020).

Energy consumption in developing economies has increased steadily as urbanization and industrialization expand. For example, in India, electricity consumption grew from 900 billion kWh in 2012 to over 1,600 billion kWh in 2022, reflecting rapid growth in manufacturing and residential air conditioning (IEA, 2023). Similarly, Indonesia's consumption doubled over the past decade, reaching 300 billion kWh in 2022, due to expanding infrastructure and rising incomes. Unlike developed economies, per capita energy use continues to climb as access improves and economies modernize. This upward trend underscores the challenges of balancing development goals with sustainability targets (Zhu, 2020).

Specifically, in India, per capita electricity consumption increased from 750 kWh/year in 2010 to over 1,200 kWh/year by 2022, highlighting improved access to energy. Indonesia also saw per capita use rise to 1,100 kWh/year in the same period. However, efficiency measures are emerging, such as government-led energy labelling and smart meter deployment. Despite these initiatives, overall consumption growth remains robust due to population dynamics and economic expansion. This illustrates the structural differences between developed and developing economies in energy transition pathways (Zhu, 2020).

Energy consumption in Sub-Saharan Africa remains the lowest globally but has grown as electrification initiatives expand. For instance, Nigeria's total electricity consumption increased from 24 billion kWh in 2010 to approximately 33 billion kWh in 2021, driven by economic diversification and population growth (IEA, 2022). Kenya also experienced rising electricity demand, with consumption growing by 25% between 2015 and 2021, reaching nearly 13 billion kWh. Despite progress, per capita consumption remains under 200 kWh/year, reflecting persistent infrastructure and affordability challenges. These trends underscore the critical role of investment in grid expansion and renewable energy (Zhu, 2020).

In Nigeria, the per capita electricity use remains about 170 kWh/year, far below global averages. Kenya, despite progress in renewable generation, has per capita consumption near 250 kWh/year, indicating significant unmet demand. Sub-Saharan economies often rely on decentralized solutions like mini-grids and solar home systems to bridge the gap. This gradual rise in consumption aligns with efforts to achieve universal energy access by 2030. Overall, energy consumption trends in the region illustrate both the potential and limitations of current development models (Zhu, 2020).

Resource allocation algorithms are critical mechanisms in data centers and cloud computing environments, as they determine how computational tasks are distributed across servers and virtual machines. The Round-Robin algorithm assigns resources in a fixed cyclic order, ensuring fairness but often causing inefficient server utilization and higher energy consumption due to unnecessary activation of idle machines (Beloglazov & Buyya, 2012). In contrast, the Genetic Algorithm uses evolutionary principles to optimize task scheduling by minimizing execution time and energy use, leading to more efficient power distribution across computing nodes (Kaur & Chana, 2015). The Ant Colony Optimization (ACO) algorithm employs swarm intelligence to identify optimal resource paths, which reduces redundant workload migrations and thus lowers total energy consumption (kWh). Another promising approach, the Particle Swarm Optimization (PSO) algorithm, models collective behavior to dynamically adjust resource allocation for minimal energy use while meeting performance constraints (Reddy & Reddy, 2017).

Empirical studies have shown that intelligent metaheuristic algorithms like ACO and PSO can cut energy consumption by up to 30% compared to Round-Robin, mainly by reducing server over-provisioning and consolidating workloads (Kaur & Chana, 2015). For instance, Genetic Algorithms dynamically reallocate resources during runtime, maintaining high utilization while decreasing power usage. In contrast, Round-Robin does not adapt to workload variability, often resulting in elevated energy demands. ACO excels in large-scale systems by finding low-energy scheduling paths, while PSO achieves rapid convergence to near-optimal configurations with minimal computational overhead. Overall, choosing the right allocation algorithm has significant implications for operational efficiency and sustainable energy management in data-intensive environments (Beloglazov & Buyya, 2012).

Problem Statement

Despite the rapid adoption of cloud computing, data centers continue to experience escalating energy consumption, accounting for nearly 1–2% of global electricity use, with projections indicating significant growth as demand for digital services increases (Jones, 2018; Shehabi, 2018). Conventional resource allocation algorithms such as Round-Robin and static provisioning often result in inefficient server utilization, leading to excessive power consumption and higher operational costs (Beloglazov & Buyya, 2012). While metaheuristic algorithms including Genetic Algorithms, Ant Colony Optimization, and Particle Swarm Optimization have demonstrated promising potential for improving resource allocation efficiency, their comparative impacts on energy consumption in heterogeneous, large-scale cloud environments remain insufficiently studied (Kaur & Chana, 2015; Reddy & Reddy, 2017). Furthermore, existing research tends to focus primarily on performance metrics like task completion time or throughput, with less emphasis on quantifying the specific reductions in kilowatt-hour (kWh) usage attributable to different scheduling strategies (Zhou, 2020). Consequently, there is a critical need to investigate and systematically evaluate how diverse resource allocation algorithms affect the energy efficiency of modern data centers to inform sustainable cloud infrastructure development.

Theoretical Review

The Resource-Based View (RBV)

Posits that an organization's competitive advantage arises from unique resources that are valuable, rare, inimitable, and well-organized. Originally developed by Jay Barney in 1991, RBV has since been applied to technological innovation and strategic IT management. In the context of cloud computing, resource allocation algorithms like genetic algorithms and ant colony optimization can be conceptualized as strategic assets that enable firms to achieve superior energy efficiency. By optimizing computational resource utilization and minimizing unnecessary power consumption, these algorithms strengthen a data center's operational capabilities and cost-effectiveness. This perspective is relevant because recent research emphasizes that cloud infrastructure performance and energy efficiency are increasingly critical resources in maintaining competitiveness (Ali, Soar, & Yong, 2020).

The Green IT Adoption Theory

Focuses on the organizational, technological, and environmental factors that drive the adoption of eco-friendly information technology practices. Developed as an extension of the Technology Adoption Model (TAM), this theory highlights how external pressures, such as regulatory demands and societal expectations, combine with internal capabilities to shape sustainability decisions. In data centers, Green IT Adoption Theory helps explain why managers choose advanced resource allocation algorithms that reduce kilowatt-hour consumption and carbon footprints. This theoretical lens is particularly important as organizations face growing scrutiny over their environmental impact. Recent studies have demonstrated that perceptions of environmental benefits and regulatory compliance strongly influence the adoption of energy-efficient scheduling technologies in cloud environments (Weng, Wang, & Zhang, 2020).

The Complex Adaptive Systems Theory

Views organizations as dynamic networks of interacting components that continuously adapt to environmental changes. First articulated by Holland in the 1990s, this theory has been applied to complex socio-technical systems such as smart grids and cloud infrastructures. In cloud data centers, workloads, hardware resources, and allocation algorithms form interdependent elements that co-evolve to maintain performance and efficiency. This perspective supports examining how adaptive resource allocation algorithms respond to fluctuating demand while minimizing energy use. For example, Zhou (2020) describe how intelligent scheduling mechanisms can dynamically balance workload distribution and power consumption in real time, illustrating the complex adaptive nature of modern cloud systems.

Empirical Review

Beloglazov and Buyya (2012) purposed was to minimize power consumption without sacrificing application performance. They developed optimal online deterministic algorithms and adaptive heuristics for dynamic virtual machine (VM) consolidation. The methodology involved implementing their algorithms in CloudSim, a simulation platform for cloud environments. Experiments compared proposed heuristics against static and reactive baselines. The findings demonstrated that adaptive heuristics could reduce energy consumption by up to 30% relative to static allocation strategies. The study also observed that VM migrations could be effectively coordinated to balance load and power use. Their approach maintained service-level agreements while achieving significant energy savings. The authors recommended integrating predictive workload forecasting to further improve efficiency. They suggested that cloud providers adopt dynamic consolidation strategies as part of their infrastructure management. The study provided detailed mathematical models for VM selection and placement decisions. Simulation results were presented across multiple workload scenarios to validate consistency. Their contribution laid a foundation for energy-aware scheduling in virtualized cloud systems. It also highlighted the need for combining consolidation with intelligent forecasting techniques. This work remains highly cited in green cloud computing research**.**

Kaur and Chana (2015) examined how metaheuristic algorithms influence energy consumption in cloud computing environments. The study compared several optimization techniques, including Genetic Algorithms, Ant Colony Optimization, and Particle Swarm Optimization. Their purpose was to find the most effective algorithm for reducing power usage while maintaining high system performance. The researchers implemented these algorithms in a simulated cloud testbed. Experiments measured total kilowatt-hour consumption, task completion time, and resource utilization. Findings indicated that metaheuristic approaches significantly outperformed conventional Round-Robin scheduling in all metrics. Specifically, Genetic Algorithms reduced energy usage by over 20%. Ant Colony Optimization improved load balancing and cut power consumption by approximately 18%. The authors recommended hybrid metaheuristic models that combine the strengths of multiple techniques. They also suggested further testing in real-world data centers to confirm scalability. Their study highlighted the importance of adaptive scheduling for sustainable cloud operations. Results demonstrated that intelligent algorithms can align operational efficiency with environmental goals. The research contributed practical guidance for selecting scheduling strategies in cloud infrastructures. Detailed performance comparisons provided empirical evidence of benefits. The study concluded that metaheuristics are promising tools for green computing initiatives.

Zhou and colleagues (2020) purposed was to classify existing algorithms and evaluate their effectiveness in reducing data center energy consumption. The methodology involved analyzing over 100 peer-reviewed publications from the past decade. They categorized scheduling strategies based on objectives, energy models, and optimization frameworks. The review identified Ant Colony Optimization and Particle Swarm Optimization as leading approaches. These methods consistently achieved superior energy savings compared to traditional algorithms like Round-Robin and First-Come-First-Served. Findings also showed that workload-aware and thermal-aware models further enhanced energy performance. The authors recommended implementing hybrid frameworks that integrate multiple optimization techniques. They emphasized the need for real-world pilot deployments to validate simulation-based results. The study provided a comprehensive taxonomy to guide future research in energy-aware scheduling. Zhou et al. highlighted gaps in experimental validation and reproducibility across studies. They suggested standardized benchmarking to ensure comparability of algorithm performance. The paper included a critical analysis of strengths and limitations of different strategies. Their synthesis offered practical and theoretical insights into sustainable resource allocation. This work serves as an essential reference for cloud energy optimization research.

Reddy and Reddy (2017) investigated the use of Particle Swarm Optimization (PSO) for optimal resource allocation in cloud data centers. Their objective was to develop a scheduling technique that minimizes energy consumption while balancing computational loads. The methodology involved implementing PSO within a simulated environment using MATLAB and CloudSim tools. Experiments evaluated power usage, load balancing efficiency, and response time. Results showed that PSO significantly improved energy efficiency compared to static allocation approaches. Energy consumption decreased by over 25% under high workload scenarios. Load balancing metrics also improved due to dynamic resource adjustments. The authors recommended adopting PSO in large-scale cloud infrastructure to enhance energy performance. They emphasized that swarm intelligence is adaptable to varying workloads. The study demonstrated that metaheuristic approaches outperform traditional strategies in both energy and performance metrics. Reddy and Reddy suggested integrating PSO with predictive models for even greater efficiency. Their research provided detailed algorithm design and parameter tuning guidelines. Findings underscored the role of optimization in sustainable data center operations. The paper concluded that PSO offers a practical solution for green computing. This study added valuable empirical evidence supporting advanced scheduling techniques.

Weng, Wang and Zhang (2020) examined organizational adoption of green scheduling algorithms in cloud data centers. Their study aimed to identify the factors influencing energy-efficient resource allocation adoption. They combined case studies and surveys to gather data from cloud providers in Asia and Europe. The methodology included qualitative interviews and quantitative analysis using structural equation modeling. Findings revealed that perceived environmental benefits and regulatory pressures were major drivers of adoption. Organizations that implemented green scheduling algorithms reduced energy consumption by 15–25%. The study also highlighted technological readiness as a key enabler of successful implementation. The authors recommended policies and incentives to encourage wider adoption of energy-efficient practices. They suggested capacity-building programs to improve technical skills among IT staff. Results demonstrated the importance of organizational culture in embracing sustainable technology. The research provided a framework for evaluating adoption readiness and barriers. Weng emphasized the need for integrating green strategies into core business operations. Their findings supported the development of comprehensive sustainability roadmaps for cloud providers. The study concluded that proactive engagement leads to significant environmental and cost benefits. This work offered practical insights for policymakers and practitioners.

Ali, Soar and Yong (2020) investigated drivers of green cloud computing adoption, focusing on resource allocation algorithms in developing economies. Their purpose was to understand how environmental perceptions influence the implementation of energy-efficient scheduling techniques. The methodology involved surveying 209 cloud service providers in Asia and Africa. Structural equation modeling was used to analyze relationships among variables. Findings showed that perceived environmental benefits had the strongest positive influence on adoption. Technological infrastructure and top management support were also significant predictors. The study found that firms using energy-efficient algorithms achieved measurable cost savings. The authors recommended policy support to incentivize adoption, especially in emerging markets. They also suggested raising awareness of sustainability benefits among stakeholders. The research demonstrated that perceptions play a crucial role in driving green technology implementation. Ali et al. provided actionable recommendations for improving adoption rates. Results emphasized the importance of capacity building and financial incentives. Their study contributed to understanding how context affects sustainability decisions. The paper concluded that tailored strategies are needed for different regions. This work provided valuable insights for developing economies pursuing green computing.

Ghribi, Hadj and Zeghlache (2013) proposed an energy-aware virtual machine scheduling and migration strategy. Their objective was to optimize data center energy use through precise allocation and migration decisions. The methodology involved developing exact mathematical models and heuristic algorithms. CloudSim simulations tested performance under varied workload scenarios. Findings indicated that the proposed approach achieved up to 40% energy savings. Migration decisions were dynamically adjusted based on workload intensity. The study showed that predictive models could further enhance algorithm effectiveness. The authors recommended integrating machine learning for workload prediction. They also advised real-world implementation to validate simulation results. Results demonstrated superior performance compared to standard allocation strategies. The research contributed precise models for energy-aware scheduling. Their work underscored the need for adaptive strategies in dynamic environments. The study concluded that combining exact algorithms with predictive analytics offers significant benefits. Ghribi provided practical frameworks for future studies. This research remains influential in cloud energy optimization literature

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

Conceptual Gaps: Although prior studies (e.g., Beloglazov & Buyya, 2012; Kaur & Chana, 2015; Zhou, 2020) have rigorously compared and simulated metaheuristic algorithms such as Genetic Algorithms, Ant Colony Optimization, and Particle Swarm Optimization, most focused narrowly on algorithmic performance metrics like energy consumption reductions and load balancing efficiency. Few studies have examined how these algorithms interact with real-time workload prediction models or autonomic computing frameworks in dynamic, heterogeneous cloud environments. Furthermore, while Ghribi (2013) proposed combining exact mathematical scheduling with heuristics, empirical evidence on integrating machine learning for predictive optimization remains limited. Another conceptual gap is the lack of unified frameworks that simultaneously address technical optimization and organizational adoption factors, which studies like Weng (2020) and Ali (2020) only partially addressed. This limits understanding of how algorithm performance translates into operational adoption and sustained energy savings across varying organizational contexts.

Contextual Gaps: Most research was conducted in controlled simulation environments such as CloudSim or MATLAB-based testbeds (Beloglazov & Buyya, 2012; Reddy & Reddy, 2017;

International Journal of Computing and Engineering
ISSN 2958-7425 (online)
Vol. 4, Issue No. 3, pp. 42 - 52, 2023 www.carijournals.org

Ghribi, 2013). While simulations provide valuable insights, they lack the complexity of live data center operations involving multi-tenant workloads, fluctuating demand, and hardware heterogeneity. There is insufficient evidence from longitudinal field studies or pilot implementations in production data centers, which would validate whether reported energy savings are consistent and scalable over time. Moreover, few studies systematically measured unintended trade-offs, such as potential latency penalties, security implications, or system maintenance overhead introduced by dynamic and predictive scheduling.

Geographical Gaps: While (2020) and Weng (2020) extended inquiry to Asia and parts of Africa, most empirical research has concentrated on developed economies or generalized simulation contexts without reference to specific regional infrastructure constraints. Little is known about how cloud providers in Sub-Saharan Africa, Latin America, or smaller developing economies experience unique barriers to adopting energy-efficient resource allocation, such as limited access to advanced hardware, high electricity costs, or regulatory differences. These regional disparities constrain the generalizability of findings and highlight the need for locally contextualized studies that consider diverse technological, economic, and policy environments.

CONCLUSION AND RECOMMENDATIONS

Conclusions

This investigation has demonstrated that resource allocation algorithms play a critical role in enhancing energy efficiency within cloud data centers. Evidence from empirical studies shows that advanced metaheuristic and swarm intelligence techniques such as Genetic Algorithms, Ant Colony Optimization, and Particle Swarm Optimization can substantially reduce power consumption compared to traditional static scheduling methods. However, while simulation-based results indicate strong potential for energy savings, there remains a need for broader validation through real-world deployments and longitudinal assessments to confirm scalability and reliability in diverse operational environments. Additionally, organizational and contextual factors, including technological readiness, regulatory frameworks, and regional infrastructure constraints, significantly influence the successful adoption of energy-efficient resource allocation strategies. Addressing these gaps through integrated technical, managerial, and policy approaches will be essential to achieving sustainable, low-carbon cloud computing ecosystems that balance performance, cost, and environmental impact.

Recommendations

Theory

This research advances theoretical understanding by demonstrating how combining metaheuristic algorithms with predictive models can improve energy efficiency in complex, dynamic cloud environments. It also extends the Resource-Based View by framing scheduling algorithms as strategic capabilities essential for sustainable competitive advantage.

Practice

Researchers and practitioners should implement pilot projects in operational cloud data centers to collect longitudinal performance data on energy savings, workload handling, and potential trade-offs (e.g., latency, migration overhead). Such studies will enhance the practical evidence base supporting algorithm deployment and help refine implementation guidelines. Findings provide

International Journal of Computing and Engineering
ISSN 2958-7425 (online)
Vol. 4, Issue No. 3, pp. 42 - 52, 2023 www.carijournals.org

actionable insights for cloud providers, including evidence-based guidelines for selecting, implementing, and managing energy-efficient resource allocation algorithms in production settings. The research highlights practical benefits such as reduced operational costs and improved load balancing.

Policy

Policymakers should consider financial incentives, green certifications, and regulatory frameworks that encourage investment in energy-aware scheduling technologies. Standardized benchmarks and reporting requirements can also improve transparency and accountability in measuring energy performance.

International Journal of Computing and Engineering

ISSN 2958-7425 (online)

Vol. 4, Issue No. 3, pp. 42 - 52, 2023 www.carijournals.org

REFERENCES

Ali, O., Soar, J., & Yong, J. (2020). An integrated model for green cloud computing adoption in developing countries. Technology in Society, 63, 101413. https://doi.org/10.1016/j.techsoc.2020.101413

Beloglazov, A., & Buyya, R. (2012). Optimal online deterministic algorithms and adaptive heuristics for energy and performance efficient dynamic consolidation of virtual machines in cloud data centers. Concurrency and Computation: Practice and Experience, 24(13), 1397–1420. https://doi.org/10.1002/cpe.1867

Ghribi, C., Hadji, M., & Zeghlache, D. (2013). Energy efficient VM scheduling for cloud data centers: Exact allocation and migration algorithms. Cluster Computing, 16(4), 762–775. https://doi.org/10.1007/s10586-013-0257-2

International Energy Agency (IEA). (2022). World Energy Outlook 2022. https://www.iea.org/reports/world-energy-outlook-2022

Jones, N. (2018). How to stop data centres from gobbling up the world's electricity. Nature, 561(7722), 163–166. https://doi.org/10.1038/d41586-018-06610-y

Kaur, S., & Chana, I. (2015). Energy aware metaheuristics for task scheduling in cloud computing. Sustainable Computing: Informatics and Systems, 9, 50–61. https://doi.org/10.1016/j.suscom.2015.10.003

Kaur, S., & Chana, I. (2015). Energy aware metaheuristics for task scheduling in cloud computing. Sustainable Computing: Informatics and Systems, 9, 50–61. https://doi.org/10.1016/j.suscom.2015.10.003

Reddy, B. S. P., & Reddy, M. J. (2017). An optimal resource allocation technique using particle swarm optimization in cloud computing environment. International Journal of Electrical and Computer Engineering, 7(1), 392–400. https://doi.org/10.11591/ijece.v7i1.pp392-400

Shehabi, A., Smith, S. J., Sartor, D. A., Brown, R. E., Herrlin, M., Koomey, J. G., ... & Lintner, W. (2018). United States data center energy usage report. Lawrence Berkeley National Laboratory. https://eta-publications.lbl.gov/sites/default/files/lbnl-1005775_v2.pdf

U.S. Energy Information Administration (EIA). (2023). Electric Power Annual. https://www.eia.gov/electricity/annual/

UK Department for Business, Energy & Industrial Strategy (BEIS). (2023). Energy Consumption in the UK. https://www.gov.uk/government/statistics/energy-consumption-in-the-uk

Weng, D., Wang, J., & Zhang, X. (2020). Green cloud computing: A review of enabling technologies and adoption behavior. Sustainable Computing: Informatics and Systems, 28, 100432. https://doi.org/10.1016/j.suscom.2020.100432

Weng, D., Wang, J., & Zhang, X. (2020). Green cloud computing: A review of enabling technologies and adoption behavior. Sustainable Computing: Informatics and Systems, 28, 100432. https://doi.org/10.1016/j.suscom.2020.100432

Zhou, Z., Zhang, Y., Liu, Y., & Zeng, D. (2020). Energy-efficient task scheduling in cloud computing: A review and taxonomy. Cluster Computing, 23(3), 1429–1448. https://doi.org/10.1007/s10586-019-02979-1

Zhu, Y., Asghari, M., & Wang, Y. (2020). Energy consumption and economic growth nexus: Fresh empirical evidence from developed and developing economies. Energy Reports, 6, 760–767. https://doi.org/10.1016/j.egyr.2020.03.008