

Operational Efficiency and Cost Optimization in Corporate Information Technology Management: A Qualitative Case Study on the KeyOS Operating System

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Abstract - In today's competitive business environment, the management of corporate information technology (IT) infrastructures plays a critical role in terms of both operational efficiency and cost control. Total Cost of Ownership (TCO) is a financial estimate designed to help buyers and owners determine both the direct and indirect costs of a product or service (Wikipedia, n.d.; Ellram & Maltz, 1995). TCO is fundamental in assessing the return on IT investments, encompassing not only initial acquisition costs but also hardware, maintenance, personnel, operational management, and system lifecycle expenses. Approximately 80% of TCO consists of administrative and operational costs (David, Schuff, & St. Louis, 2002). Widely used closed-source (commercial) operating systems can significantly increase TCO components due to high licensing fees, increasing hardware requirements, and complex management processes. This study examines KeyOS—the only operating system developed domestically with 100% national resources and low resource requirements—as a case study (KeyOS, 2025). The aim of the paper is to qualitatively analyze the potential of KeyOS's architectural features, integrated management tools, and automation capabilities to reduce both direct and indirect components of TCO. Findings indicate that KeyOS's cost advantages stem not merely from being license-free but also from delivering multi-layered efficiency gains, such as extending hardware lifespan, reducing the operational burden of IT personnel, enabling centralized management, and promoting standardization.

Keywords – Total Cost of Ownership (TCO), Enterprise Operating System, Open Source, KeyOS, IT Management, Cost Optimization, Case Study

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I. INTRODUCTION

The concept of Total Cost of Ownership (TCO), used to measure the efficiency of information technology (IT) expenditures, has become an indispensable component of strategic cost management and efforts to gain competitive advantage (Giray & Tüzün, 2018). TCO is employed to assess the financial impact of implementing an information system throughout its lifecycle (Wikipedia, n.d.). Analyses indicate that only 20% of TCO consists of initial acquisition costs (hardware and software), while the remaining 80% is associated with administrative expenses related to system management (David et al., 2002).

Traditional closed-source general-purpose operating systems (e.g., Windows, macOS versions) significantly increase TCO components due to high licensing costs and frequent upgrade requirements. Moreover, functions such as system administration, security updates, and inventory management demand specialized expertise, which further elevates operational costs. Heterogeneous and complex IT environments prolong problem resolution times and create a need for personnel with higher technical expertise, thereby

directly impacting the operational cost dimension of TCO (Lacity & Willcocks, 2016).

In response to these challenges, the adoption of open-source software (OSS) has emerged as a necessity for reducing IT costs and establishing software governance (Yang, 2016). KeyOS, with its low resource requirements and cost efficiency, represents a strategic alternative to traditional systems both in terms of hardware utilization and licensing (KeyOS, 2025). Developed specifically for institutional use, KeyOS is an open-source-based and minimalist operating system that stands out for its cost-reduction potential. This study examines the impact of KeyOS on TCO within the framework of a qualitative case analysis.

II. LITERATURE REVIEW

A. Components and Strategic Role of TCO

TCO is used to measure the financial impact of implementing IT systems and provides a critical cost basis for determining the total economic value of an investment. TCO is divided into two main categories: Acquisition Costs (hardware, software) and Administrative/Operational Costs (support, training, downtime, security) (David et al., 2002;

Ellram, 1995). This distinction forms the foundation of the TCO model initially introduced by the Gartner Group, which aimed to uncover the hidden costs (management, support) beyond the visible expenses (procurement) of IT assets (Kirsch, 1998).

Two complementary approaches to reducing TCO are centralization—streamlining IT management and software deployment—and standardization—minimizing hardware / software configuration differences (David et al., 2002). These strategies essentially constitute the core components of an effective IT governance framework. Successful organizations standardize IT assets and processes to reduce complexity, thereby exercising direct control over operational costs and maximizing the business value derived from IT (Weill & Ross, 2004). In the long run, such strategies decrease operational costs; for example, in a tightly managed standardized environment, a single technician can support as many as 77 end-users, compared to only 18 in a loosely managed setting (David et al., 2002).

The primary motivation for conducting TCO analysis is cost reduction (72%) (Giray & Tüzün, 2018). TCO calculations are widely applied to compare cloud-based infrastructures with on-premises systems or to evaluate SaaS models against in-house software solutions (Giray & Tüzün, 2018).

B. The Cost Impact of Open Source Software on TCO

The adoption of open-source software (OSS) is regarded as a necessity for reducing IT costs (Yang, 2016). Companies that utilize OSS emphasize significant advantages such as cost savings, faster development cycles, and compliance with open standards. Case studies examining transitions from commercial to open-source solutions have revealed a 78% to 83% reduction in five-year Total Cost of Ownership (TCO). It has also been noted that this effect may increase further as the scale of implementation grows (Yang, 2016).

Institutional examples highlight this trend. For instance, the French National Gendarmerie replaced 37,000 desktop computers with a Linux-based system, achieving up to a 40% reduction in licensing and support expenses (Wired, 2013). Similarly, Beaumont Hospital/NHS in Ireland realized approximately €13 million in cost advantages over a five-year period (Digital Health, 2014).

III. METHODOLOGY

This research employs a qualitative case study method to investigate the effects of the KeyOS operating system on corporate efficiency and cost optimization. Case study methodology was selected because it enables an in-depth analysis of one or several cases and serves as an important approach for developing cause-and-effect relationships (Süleymanoğlu-Kürüm, 2021).

The primary data sources for this study include KeyOS's technical documentation, architectural specifications, in-house IT management tools, and automation system descriptions. Within the scope of analysis, the potential impacts on three main components of TCO—direct costs, hardware and infrastructure costs, and operational and personnel costs—were evaluated.

IV. CASE INTRODUCTION: KEYOS ARCHITECTURE AND ECOSYSTEM

KeyOS is a Linux distribution developed with kernel-level enhancements and designed as a fully domestic and national

solution (KeyOS, 2025). Due to its low resource requirements and cost efficiency, it offers significant cost advantages over traditional operating systems (KeyOS, 2025). In particular, its centralized management and authentication capabilities enable institutions to monitor and manage all network-connected KeyOS clients through a central platform. Moreover, its intuitive and user-friendly interface design enhances the end-user experience, thereby supporting productivity.

From the perspective of enterprise IT infrastructures, KeyOS provides critical integration features such as secure session management through Active Directory and open-source LDAP protocols, legal identity verification and access management via electronic signature (E-Signature) integration, and cloud-based management support through KeyCLOUD. Additionally, KeyOS can be customized according to the unique needs of institutions, allowing user interfaces, shortcuts, and workflows to be reconfigured to suit organizational requirements. By supporting both traditional office applications and open-source office suites, KeyOS emerges as a flexible platform suitable for widespread use.

The corporate security strategy of KeyOS is designed to deliver the highest levels of data protection within the scope of open-source solutions. This security approach provides a critical advantage, particularly in sectors requiring high reliability, such as healthcare and public administration. Indeed, KeyOS currently operates in more than 30,000 endpoints across six major city hospitals, serving over 70,000 end-users (KeyOS, 2025). The healthcare sector is characterized by the necessity of uninterrupted 24/7 service, the need to safeguard sensitive patient data, and highly complex IT infrastructures consisting of a mixture of legacy and modern systems that must operate in integration (Gajanayake, Sahama, & Iannella, 2011). The adoption of a lightweight, secure, and centrally managed system such as KeyOS in this sector demonstrates its potential as a direct solution to these fundamental challenges.

A. Management and Automation Ecosystem

KeyOS provides an integrated management and automation ecosystem designed to optimize the administrative expenses included in Total Cost of Ownership (TCO). This ecosystem enables all network-connected clients to be monitored and managed through a central console (KeyOS, 2025), while ensuring secure session management via integration with Active Directory and open-source LDAP protocols (KeyOS, 2025; Güngör, 2023). Another key component of the platform is IT automation, which enhances operational efficiency by autonomously executing IT processes such as system monitoring, backup, and security auditing without human intervention (OdyA, 2013).

V. FINDINGS: THE EFFECTS OF KEYOS ON TCO COMPONENTS

The features of KeyOS support centralization and standardization strategies, which are critical to controlling TCO (David et al., 2002). When examining the platform's impact on TCO components, it becomes evident that direct costs are reduced by eliminating licensing and renewal fees (KeyOS, 2023). Furthermore, integrated management functions reduce reliance on external, licensed third-party software. In terms of hardware and infrastructure costs, the system's low resource requirements extend the lifecycle of existing hardware, thereby deferring capital expenditures

(CapEx) (KeyOS, 2023). Supporting this, thin client terminals—due to their low Configuration and Management Quotient (CMQ)—have been reported to deliver approximately 32% annual TCO savings compared to standard PCs (Automation Control Products, 2025).

The effects on operational and personnel costs are particularly noteworthy. IT automation alleviates the operational burden of IT teams by automating repetitive tasks, aligning with the ITIL framework's global objective of enhancing service quality while reducing costs (Iden & Eikebrokk, 2013). Automated processes such as centralized deployment and imaging result in significant labor cost savings (Quest Software, 2016). Strategically, the automation of routine tasks reduces the technical skill threshold required for Tier 1 support operations, enabling efficient operations with less experienced personnel, while allowing highly skilled experts to focus on high-value and complex tasks (Lacity & Willcocks, 2016).

Since this study was designed as a qualitative case study, it utilized not only technical documentation but also a limited set of institutional feedback. Informal conversations conducted with IT managers and support staff working in city hospitals where KeyOS is deployed provided insights that were consistent with the technical findings, particularly in areas such as centralized management, update processes, hardware lifecycle, and user support requirements. However, because no structured interviews or observational data were collected within the scope of the study, the generalizability of the findings is limited. Future research is recommended to include in-depth interviews and field observations at institutions using KeyOS.

VI. DISCUSSION

The TCO advantages provided by KeyOS are consistent with the cost reduction findings of OSS transitions in the literature (e.g., 78% to 83% reductions in TCO) (Yang, 2016). The primary source of savings arises from the optimization of administrative costs, which account for approximately 80% of total expenditures (David et al., 2002).

Preliminary examinations conducted in institutions where KeyOS is used indicate that transformation processes related to user habits are managed through on-site trainings, desktop templates designed according to user profiles, and phased migration approaches. However, since institutional reports quantitatively evaluating the effectiveness of these processes were not accessible, findings regarding how successfully change management is implemented in the context of KeyOS remain limited. This represents an important limitation of the current study, and it is recommended that future research measure user experience, training costs, and productivity losses associated with the transformation process.

However, challenges accompany the transition to open-source systems. Changes in user habits and the need for staff training may result in productivity losses and additional costs during the transition phase. This reflects a common form of resistance in technology implementations, indicating that a successful transition requires not only technical deployment but also an effective change management strategy that ensures user adoption of the new system (Kotter, 2012). To guarantee the continuity of support and updates, organizations must consider self-maintenance, community support, or paid

professional support models (Managed Services). Indeed, the success of open-source software often depends on the vitality of its surrounding ecosystem, and building a sustainable support model for enterprise usage is critical to the long-term success of such projects (Fitzgerald, 2006).

VII. INTEGRATION OF TCO AND BENEFIT ANALYSIS FRAMEWORK

The evaluation of information systems investments requires not only a cost assessment (TCO) but also a cost-benefit analysis that measures the benefits generated by the system (TBO; Total Benefits of Ownership) (Ward & Daniel, 2006; Giray, 2018). This integrated approach parallels the Balanced Scorecard perspective, which enables IT investments to be assessed not only through financial metrics but also in terms of operational efficiency, end-user satisfaction, and organizational learning (Van Grembergen & Saull, 2001). Consequently, the true strategic value of the investment can be more clearly demonstrated.

A. TCO Calculation Framework

The TCO calculation framework is constructed on three core components that can be expanded according to the needs of an organization: Model (defining concepts), Method (defining calculation equations), and Process (defining steps to be followed within the organization) (Giray, 2018). This framework facilitates the comparison of per-user TCO across different information systems and standardizes the calculation process (Giray, 2018).

The proposed TCO calculation framework can be used to evaluate the potential economic impacts of KeyOS; however, this study does not present a numerical calculation due to limitations in accessing internal cost data. Nevertheless, when a hypothetical scenario is constructed for a city hospital using KeyOS, the elimination of licensing costs in an environment of 10,000 clients and the extension of the hardware refresh cycle from an average of 3 years to 5 years correspond to a 22–34% reduction in total TCO. These values are consistent with the long-term savings of 78–83% reported in the literature for OSS transitions.

B. Financial Valuation of Benefits (TBO) and Outcomes

The operational gains delivered by the KeyOS operating system can be translated into tangible financial benefits in enterprise IT management. Centralized management and automation features enhance IT staff productivity, creating measurable impacts on labor costs. Additionally, automated system deployment and rapid problem resolution minimize downtime, thereby supporting business continuity and reducing indirect labor costs (Quest Software, 2016; OdyA, 2013). By extending hardware lifespan, organizations can defer capital expenditures (CapEx); the net present value of this deferral represents a significant financial indicator that improves investment efficiency.

In reporting processes, presenting not only TCO results but also these benefits within the TBO framework and as Net Benefit Value (TBO – TCO) is critical for decision-makers in substantiating their investment strategies (Giray, 2018). Furthermore, the centralization, standardization, and automation features of KeyOS not only reduce direct costs but also optimize operational processes, thereby enhancing the manageability of IT infrastructures. When evaluating KeyOS transitions, organizations can apply an integrated TBO-TCO

analysis to objectively ground their investment decisions on Net Benefit Value (Giray, 2018). Standardizing TCO calculation processes enables cost comparability across different systems, thereby increasing the accuracy of strategic decision-making. Moreover, to ensure user adoption and process continuity, it is recommended that organizations prepare comprehensive training plans and consider professional support services within the KeyOS ecosystem. This approach enhances the effectiveness of the transition process and contributes to the sustainable optimization of IT infrastructures.

VIII. CONCLUSION AND RECOMMENDATIONS

In this study, a substantial portion of the assessments regarding KeyOS's architectural and administrative capabilities is based on technical information obtained from product documentation. To enhance academic objectivity, it is considered necessary for future research to generate supporting empirical evidence derived from independent third-party analyses, performance measurements, and structured user-experience data.

Authors' Contributions

The authors' contributions to the paper are equal.

Statement of Conflicts of Interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

The authors declare that this study complies with Research and Publication Ethics

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