



Business Process Automation and Firm Performance: Evidence from Container Freight Stations in Kenya

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Abstract

The study evaluated the effect of business process automation on the performance of Container Freight Stations (CFSs) in Kenya. Positivism and interpretivism philosophies guided the adoption of an explanatory sequential mixed methods design. The target population was 38 Container freight Stations in Kenya. The study adopted a census of all 38 licensed CFSs operating in Kenya, with 136 respondents participating in the survey, while 13 respondents participated in the interview. Structured questionnaires and key informant interviews were administered. The quantitative data were analysed based on a multiple linear regression model with the help of the Statistical Package for Social Sciences version 25. The qualitative data were analysed based on content analysis with the assistance of ATLAS.ti, software. Business process automation sub-constructs: cargo handling automation and the track appointment system significantly affected the performance indicators of CFSs in Kenya. The study concluded that business process automation was significantly associated with revenue growth, operational efficiency, and customer satisfaction. The management of CFSs in Kenya should scale up business process automation via an interoperable cargo clearance system, streamlined cargo handling automation, and track appointment system to improve service efficiency.

Introduction

The rapid growth of global trade and containerised cargo movement has fundamentally transformed logistics and supply chain operations, placing unprecedented pressure on ports, inland terminals, and freight handling facilities worldwide (Essel et al., 2022). Across the globe, seaports and container freight facilities are increasingly confronted with severe operational challenges such as congestion, lengthy cargo dwell times, restricted handling capacity, rising operational costs, delayed vessel turnaround, and inefficiencies in cargo coordination systems (Wibowo & Fransoo, 2023; Horng et al., 2024). In response, logistics firms are under immense pressure to improve operational efficiency, service quality, and revenue growth to maintain competitiveness and profitability (Gituma, 2019). Consequently, organisational performance in logistics firms has become increasingly dependent on the adoption of advanced technologies such as business process automation that is capable of improving operational efficiencies and supporting rapid decision-making processes (Brás et al., 2023). Business Process Automation involves the use of technologies such as artificial intelligence, robotics, cloud computing, and integrated digital platforms to streamline organisational operations and eliminate repetitive manual activities (Beerbaum, 2022). Evidence from the United States showed enhanced productivity, reduced delivery times, and improved quality control through automated systems integration (Nguyen et al., 2022). In Germany, automation technologies improved warehouse management, sales coordination, and cost accounting efficiency, resulting in enhanced organisational



performance (Beerbaum, 2022). Similarly, container terminals in Turkey experienced substantial reductions in ship turnaround times and transport vehicle waiting periods following the implementation of automation systems (Jobran & Kara, 2022). Africa's logistics systems continue to experience infrastructural deficiencies, operational inefficiencies, and slow technological adoption despite increasing trade volumes and growing demand for efficient freight services (Adekunle & Remi, 2023; Oni & Ojekunle, 2023). In Kenya, the establishment of Container Freight Stations (CFSs) in 2007 was intended to decongest the Port of Mombasa and improve cargo handling efficiency by facilitating off-port storage, consolidation, and deconsolidation services (Lamarque, 2019; Kenya Ports Authority, 2022). Nevertheless, increased competition from Inland Container Depots (ICDs), improvements in port efficiency, expansion of the Standard Gauge Railway (SGR), and changing logistics dynamics have significantly reduced the business volumes handled by CFSs, thereby exposing them to declining profitability and operational instability (Amiru & Aosa, 2019). There is therefore the need for urgent technological and operational solutions capable of revitalising the performance of CFSs in Kenya (Murugi, 2022; AlMulhim, 2021).

Despite the previous studies, research gaps remain in the literature. Conceptually, most existing studies have focused on isolated dimensions of business process automation (Jobran & Kara, 2022). Contextually, the majority of studies were undertaken in developed economies such as Germany, the United Kingdom, South Korea, Turkey, and the United States, whose operational, infrastructural, and technological environments substantially differ from those of Kenya and Sub-Saharan Africa (Qaffas et al., 2023). Methodologically, most studies have heavily relied on Partial Least Squares Structural Equation Modelling (PLS-SEM), meta-analysis, and case study approaches, with limited firm-level insights into the operational realities of logistics firms (Filom et al., 2022). This study, therefore, examined the effect of Business Process Automation on performance among CFSs in Kenya while adopting a mixed methodology approach. The study conceptualised Business Process Automation through various sub-constructs: cargo handling automation, cargo clearance system and track appointment system. Further, the performance of CFSs was examined through indicators including operational efficiency, revenue growth and customer satisfaction. The study was anchored on the System Theory, which conceptualises business process automation as an interconnected system of technologies and processes that enhance coordination, reduce inefficiencies, and improve overall system performance (von Bertalanffy, 1968). The study was thus informed by the hypotheses:

H₀₁: The track appointment system has no significant effect on the performance of CFS in Kenya.

H₀₂: Cargo handling automation has no significant effect on the performance of CFS in Kenya.

H₀₃: The cargo clearance system has no significant effect on the performance of CFS in Kenya.

Methods and Materials

Research Design, Target Population and Sampling

A dual-philosophy alignment, including positivism and interpretivism, provided a coherent justification for an explanatory sequential mixed-method design combining quantitative and qualitative approaches in a structured two-phase sequence, typically beginning with quantitative analysis followed by qualitative explanation. The study adopted a census of 38 CFSs in Kenya licensed by the Kenya Ports Authority (KPA). For the quantitative component, the study purposively targeted five functional managers from each CFS, specifically from Operations, Information and Communications Technology (ICT), General Management, Human Resources, and Clearing and Forwarding departments. This generated a sampling intention of $38 \times 5 = 190$ respondents for the survey questionnaire. The choice to select five respondents from each CFS was based on the necessity to gather varied managerial insights from the essential functional areas. For the qualitative component, one key informant from each CFS, either the Facility Operator or Chief Executive Officer (CEO), was



targeted to participate in Key Informant Interviews (KIIs). This generated a sampling intention of 38 qualitative respondents. The qualitative respondents were high-level decision-makers with detailed insights, clarifications, and contextual explanations related to the matters being examined. However, after 24 respondents (20 surveys and 4 interviews) from 4 CFSs were excluded from the final study for participating in the pilot study, and another 55 (34 surveys and 21 interviews) respondents failed to participate in the study due to non-response and saturation, respectively, the realised sample size was 136 respondents in the survey and 13 respondents in the interview (Hennink et al., 2017).

Data Collection and Analysis

The study used a structured questionnaire based on a five-point Likert scale and an interview schedule containing open-ended questions aligned with the study objectives. A pilot study was conducted in four randomly selected Container Freight Stations (10% of the sample), following recommendations by Mugenda and Mugenda (2003). Reliability was confirmed through Cronbach's alpha coefficients above 0.70 for all constructs: track appointment system (0.945), cargo handling automation (0.872), cargo clearance system (0.943), revenue growth (0.879), operational efficiency (0.890), and customer satisfaction (0.785). Construct validity was established as all Average Variance Extracted (AVE) values exceeded 0.60. Quantitative data were analysed using SPSS version 25 through descriptive statistics, diagnostic tests, and multiple linear regression models for hypothesis testing. The hypothesis was tested based on multiple linear Equations (1-3).

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \quad (1)$$

$$Y_2 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \quad (2)$$

$$Y_3 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \quad (3)$$

Where Y_1 = revenue growth, Y_2 = operational efficiency, Y_3 = customer satisfaction, X_1 = track appointment system, X_2 = cargo handling automation, X_3 = cargo clearance system, β_0 = intercept term, β_1 - β_3 = coefficients of business process automation constructs. ε = error term. Qualitative data were analysed using thematic analysis. Interview recordings and field notes were transcribed verbatim, verified for accuracy, and reviewed repeatedly before open coding was conducted using ATLAS.ti software. Trustworthiness was enhanced through member checking, audit trails, and the use of verbatim quotations. Ethical approval was obtained through an introductory letter from the ethics review committee of United States International University (USIU), which facilitated the acquisition of a research permit from the National Commission for Science, Technology and Innovation (NACOSTI) (Permit No. NACOSTI/P/25/4173200). Respondents were informed about the study and provided informed consent. Confidentiality was ensured through password-protected data storage and the use of respondent codes to protect participants' identities.

Results

Descriptive Statistical Analysis

The descriptive analysis was based on responses on a 5-point Likert Scale. The responses were then analysed using percentages, mean and standard deviation. The construct business process automation included three sub-constructs: Cargo handling automation, cargo clearance system and track appointment system.



Table 1: Descriptive Analysis of Track Appointment System

Statements (n = 136)	Not at all (%)	Small Extent (%)	Moderate Extent (%)	Large Extent (%)	Very Large Extent (%)	μ	σ
The firm has an online track booking interface for transporters.	2.2	8.8	32.4	32.4	24.3	3.68	1.01
The system allows for appointment modifications.	2.9	5.9	36.0	31.6	23.5	3.67	0.99
The system supports prioritisation of critical shipments, such as perishable or time-sensitive goods.	2.2	11.0	30.1	31.6	25.0	3.66	1.04
The track appointment system controls the congestion problem at the facility.	3.7	8.8	30.1	33.8	23.5	3.65	1.05
Cameras automatically record vehicle plates to allow entry or exit.	6.6	8.8	26.5	38.2	19.9	3.56	1.10
The firm uses biometric or card-based systems for personnel and vehicle access into and out of the organisation.	3.7	11.8	27.9	28.7	27.9	3.65	1.11
The firm opens the gates automatically upon successful verification.	5.9	14.7	29.4	30.1	19.9	3.43	1.14
Overall mean						3.64	1.05

μ = mean response, and σ = Standard deviation

The findings (Table 1) indicate that most respondents perceived substantial implementation of track appointment and gate access technologies within their firms. Specifically, 56.7% reported that their organisations had an online track booking interface enabling carriers to reserve gate access time slots ($\mu = 3.68, \sigma = 1.01$). Similarly, 55.1% indicated that the system supported appointment modifications, rescheduling, and cancellations ($\mu = 3.67, \sigma = 0.997$), while 56.6% noted that it facilitated prioritisation of critical shipments such as perishable or time-sensitive goods ($\mu = 3.66, \sigma = 1.042$). A majority (57.3%) further agreed that the appointment system helped control congestion at the facility ($\mu = 3.65, \sigma = 1.051$). Regarding access control technologies, 58.1% reported the use of automatic number plate recognition cameras for vehicle entry and exit management ($\mu = 3.56, \sigma = 1.107$), while 56.6% confirmed the use of biometric or card-based access systems ($\mu = 3.65, \sigma = 1.118$). However, automated gate opening upon successful vehicle verification was less prevalent ($\mu = 3.43, \sigma = 1.14$).

The findings on cargo handling automation (Table 2) indicate moderate to high adoption of automated technologies in cargo operations. Half of the respondents (50%) reported that their firms used Automated Guided Vehicles (AGVs) to move containers within facilities ($\mu = 3.47, \sigma = 1.154$). A larger proportion (58.8%) indicated that firms had adequate cargo-handling equipment, including lifts and cranes, for loading and offloading containers ($\mu = 3.68, \sigma = 1.017$). The use of robotics was relatively limited, with only 27.2% reporting that robots assisted workers in tasks such as cargo sorting and labelling ($\mu = 2.82, \sigma = 1.156$). Additionally, 43.3% noted that conveyor belts were used to facilitate the movement of smaller cargo within the facility ($\mu = 3.34, \sigma = 1.137$). The highest level of adoption was observed in sensor-enabled cranes used for efficient container stacking and retrieval, as reported by 59.5% of respondents ($\mu = 3.75, \sigma = 1.066$). Similarly, 57.3% confirmed the use of automated carriers for container movement and stacking ($\mu = 3.69, \sigma = 1.119$).



Table 2: Descriptive Analysis of Cargo Handling Automation

Statements (n=136)	Not at all	Small Extent	Moderate Extent	Large Extent	Very Large Extent	μ	σ
	(%)	(%)	(%)	(%)	(%)		
The firm uses automated Guided Vehicles to move containers.	6.6	11.8	31.6	27.9	22.1	3.47	1.15
The firm has adequate cargo handling machines, such as lifts.	2.2	10.3	28.7	35.3	23.5	3.68	1.01
Robots assist human workers in tasks like cargo sorting.	11.0	33.8	27.9	16.9	10.3	2.82	1.15
The firm uses conveyor belts for smaller cargo to movement.	8.1	11.0	37.5	25.7	17.6	3.34	1.13
Cranes with sensors efficiently stack and retrieve containers.	3.7	6.6	30.1	30.1	29.4	3.75	1.06
The firm uses automated carriers to move containers.	4.4	8.8	29.4	27.9	29.4	3.69	1.11
Overall mean						3.458	1.108

μ = mean response, and σ = Standard deviation

The findings (Table 3) indicate a high level of adoption of cargo clearance systems among the surveyed firms (82.4%; $\mu = 4.33$, $\sigma = 1.01$) that enable seamless document exchange among stakeholders (83.8%; $\mu = 4.17$, $\sigma = 0.89$). A substantial majority also reported integration with the Kenya Revenue Authority (KRA) customs platforms to expedite clearances (85.2%; $\mu = 4.20$, $\sigma = 0.90$). The highest level of agreement was recorded for automated notifications on clearance milestones, pending actions, and document requirements (87.5%; $\mu = 4.29$, $\sigma = 0.87$). Additionally, respondents noted that the systems operate around the clock (80.9%; $\mu = 4.23$, $\sigma = 0.91$), support online calculation and payment of duties and taxes (83.1%; $\mu = 4.18$, $\sigma = 1.04$), automate billing and invoicing (85.3%; $\mu = 4.20$, $\sigma = 0.87$), and track regulatory approval statuses (83.8%; $\mu = 4.23$, $\sigma = 0.97$).

Table 3: Descriptive Analysis of Cargo Clearance System

Statement (n=136)	Not at all	Small Extent	Moderate Extent	Large Extent	Very large extent	μ	σ
	(%)	(%)	(%)	(%)	(%)		
The firm has implemented a cargo clearance system.	2.9	3.7	11.0	22.1	60.3	4.33	1.01
The cargo clearance system enables seamless exchange of documents.	1.5	4.4	10.3	43.4	40.4	4.17	0.89
The cargo clearance system interfaces with the national customs platforms.	2.2	3.7	8.8	42.6	42.6	4.2	0.90
The system sends notifications on clearance milestones.	2.2	2.2	8.1	39.0	48.5	4.29	0.87
The cargo clearance system installed is responsive around the clock.	1.5	2.9	14.7	33.1	47.8	4.23	0.91
The system allows users to calculate and pay duties, taxes, and fees online.	4.4	3.7	8.8	35.3	47.8	4.18	1.04
The system automatically bills customers and generates invoices.	2.2	2.2	10.3	44.1	41.2	4.20	0.87
The system tracks the status of approvals required from customs.	2.9	3.7	9.6	35.3	48.5	4.23	0.97
Overall mean						4.22	0.93

μ = mean response, and σ = Standard deviation



The descriptive findings in Table 4 provide a detailed assessment of the performance of CFSs in Kenya, evaluated through three primary dimensions: revenue growth, operational efficiency, and customer satisfaction. Across a sample of 136 respondents ($n=136$), the performance indicators demonstrate a generally positive trend from 2021 to 2024, supported by an overall composite mean score of 3.66 and a standard deviation of 1.00, indicating a moderate level of consensus among the surveyed firms. The assertion that firm profits have risen consistently achieved the highest level of agreement within this sub-construct, yielding a mean score of 3.83 and a standard deviation of 0.98, with more than half of the respondents (55.9%) either agreeing or strongly agreeing. Similarly, non-demurrage revenues exhibited stable upward growth ($\mu = 3.71$, $\sigma = 0.93$), backed by a combined agreement of 55.1%. Demurrage fee collection also experienced a steady increase ($\mu = 3.65$, $\sigma = 0.97$), though it garnered slightly less agreement (51.5%) than other revenue streams. Collectively, these metrics indicate that Kenyan CFSs have successfully expanded both their core operational and penalty-based revenue segments.

A significant proportion of firms managed to keep cargo clearance times below the 60-hour threshold recommended by the Kenya Ports Authority (KPA), resulting in a high mean score of 3.83 ($\sigma = 0.99$), with 65.5% of respondents confirming compliance. Furthermore, truck turnaround times were reported to have decreased consistently ($\mu = 3.79$, $\sigma = 0.98$), while facility capacity utilisation remained robust, with firms operating above 70% of their design capacity ($\mu = 3.66$, $\sigma = 1.02$). Cost management efforts were also viewed favourably; 52.2% of the respondents agreed or strongly agreed that operational costs as a ratio of profits have been on a consistent decline ($\mu = 3.61$, $\sigma = 0.95$). However, the statement regarding a significant increase in contraband cargo incidences from 2021 to 2024 registered a mean score of 3.35 ($\sigma = 1.07$). Since 47.0% of respondents agreed or strongly agreed with this trend, it indicates that while logistical throughput has improved, risk management systems face growing pressure.

Firms demonstrated a strong capacity to retain their clientele, as evidenced by a decline in customer attrition ($\mu = 3.84$, $\sigma = 1.05$) and a parallel increase in repeated customers ($\mu = 3.76$, $\sigma = 1.05$). This retention is supported by an upward trajectory in formal customer satisfaction scores ($\mu = 3.77$, $\sigma = 1.05$) and notable gains in labour productivity ($\mu = 3.79$, $\sigma = 0.99$). Innovation also remained steady, with a majority of firms confirming the consistent introduction of new products ($\mu = 3.57$, $\sigma = 1.01$). In contrast to these positive metrics, the firms' overall market share dynamics present a paradox. The statement that market share has been declining consistently returned a mean score of 3.20 ($\sigma = 1.04$), with 45.6% of respondents agreeing or strongly agreeing. This suggests that despite achieving high customer satisfaction, labour productivity, and repeat business within their existing operations, individual CFSs may be facing intensified industry competition or a fragmenting market landscape that threatens their broader market dominance.



Table 4: Descriptive Analysis of Performance of Container Freight Stations in Kenya

Statement (n=136)	Strongly Disagree (%)	Disagree (%)	Somewhat Agree (%)	Agree (%)	Strongly Agree (%)	μ	σ
Revenue growth							
Your firm's profits have increased consistently from 2021 to 2024.	0.0	6.6	37.5	22.1	33.8	3.83	0.98
Your firm's demurrage fees collection has increased consistently from 2021 to 2024.	0.7	8.8	39.0	27.2	24.3	3.65	0.97
Your firm's non-demurrage revenues have increased consistently from 2021 to 2024.	0.7	6.6	37.5	31.6	23.5	3.71	0.93
Operational Efficiency							
Your firm's cargo clearance time is below 60 hours as recommended by KPA.	1.5	8.1	25.0	36.8	28.7	3.83	0.99
Your firm's truck turnaround time has reduced significantly from 2021 to 2024.	0.0	11.0	27.2	33.8	27.90%	3.79	0.98
Your firm's contraband cargo incidents have increased significantly from 2021 to 2024.	2.2	23.5	27.2	31.6	15.40%	3.35	1.07
Your firm's operational costs as a ratio of profits have been declining consistently from 2021 to 2024.	0.7	10.3	36.8	31.6	20.60%	3.61	0.95
Your firm's facility is operating above 70% of its design capacity.	2.2	8.8	34.6	29.4	25.00%	3.66	1.02
Customer Satisfaction							
Your firm's market share has been declining consistently from 2021 to 2024.	5.1	22.8	26.5	38.2	7.40%	3.2	1.04
Your firm has consistently introduced new products from 2021 to 2024.	1.5	13.2	33.1	31.6	20.60%	3.57	1.01
The productivity of labour has increased significantly from 2021 to 2024.	0.7	10.3	25.7	35.3	27.90%	3.79	0.99
Your firm's repeated customers have been on the rise consistently from 2021 to 2024.	2.9	5.9	34.6	25.7	30.90%	3.76	1.05
Your firm's customer satisfaction scores increased consistently from 2021 to 2024.	2.2	8.8	28.7	30.1	30.10%	3.77	1.05
Customer attrition has been declining consistently from 2021 to 2024.	2.9	5.9	28.7	29.4	33.10%	3.84	1.05
Overall Mean						3.66	1.00

μ = mean response, and σ = Standard deviation



Diagnostic Tests

The Kolmogorov–Smirnov test for normality showed that all variables yielded p-values surpassing the 0.05 threshold: Track Appointment System (0.200), cargo handling automation (0.200), cargo clearance system (0.180), revenue growth (0.200), operational efficiency (0.200) and customer satisfaction (0.190). Further, the Shapiro–Wilk test similarly affirmed the normal distribution adequacy of all variables with corresponding significance values ranging between 0.165 and 0.240. The variance inflation factor (VIF) measure of multicollinearity showed that the independent variables had VIF values less than 5: Track Appointment System (4.932), cargo handling automation (4.596), and cargo clearance system (2.131). Further, tolerance values exceeded 0.10: Track Appointment System (0.203), cargo handling automation (0.218), and cargo clearance system (0.469). The VIF values were below the threshold of 5, indicating the absence of severe multicollinearity. However, the Track Appointment System exhibited a VIF value close to the upper acceptable limit, suggesting moderate shared variance with other explanatory variables. This may slightly inflate standard errors and reduce coefficient stability, though not to a level sufficient to threaten model estimation. The Breusch–Pagan test conducted across all three multiple regression models (1-3) confirmed that the error variances were homoscedastic (p-values >0.05). The Ramsey RESET test result for the functional form misspecification was not statistically significant (p > 0.05), suggesting that the linear functional form was appropriate. Finally, Harman’s single-factor test for common method variance revealed multiple factors with eigenvalues greater than 1, and the first factor accounted for 32.4% of the total variance, which is below the recommended threshold of 50%. This suggests that common method variance was not a significant concern in the study.

Regression Analysis

The study undertook multiple regression analysis to examine the effect of business process automation sub-constructs on sub-constructs of performance of container freight stations in Kenya. The regression output is shown in Table 5.

Table 5: Regression Analysis Output

Independent Variable	Revenue Growth (Y ₁)	Operational Efficiency (Y ₂)	Customer Satisfaction (Y ₃)
Constant (Intercept)	0.878 (0.248)***	0.969 (0.249)***	0.676 (0.248)***
Track Appointment System (X ₁)	0.461 (0.109)***	0.466 (0.110)***	0.422 (0.109)***
Cargo Handling Automation (X ₂)	0.325 (0.113)**	0.315 (0.113)**	0.298 (0.113)**
Cargo Clearance System (X ₃)	0.040 (0.084)	0.024 (0.084)	0.121 (0.084)
R Square (R ²)	0.629	0.603	0.625
F-Statistic	74.693	66.763	73.482
Model Significance (p-value)	0.000	0.000	0.000

Significance Levels *** p < 0.01 ** p < 0.05 *p < 0.10, Standard errors are in parentheses

$$Y_1 = 0.878 + 0.461X_1 + 0.325 X_2 + 0.040 X_3 + \epsilon \dots\dots\dots [1]$$

$$Y_2 = 0.969 + 0.466 X_1 + 0.315 X_2 + 0.024 X_3 + \epsilon \dots\dots\dots [2]$$

$$Y_3 = 0.676 + 0.422 X_1 + 0.298 X_2 + 0.121 X_3 + \epsilon \dots\dots\dots [3]$$

The coefficients of determination (R² = .629; R² = 0.603; R² = 0.625) revealed that business process automation accounted for 62.9%, 60.3% and 62.5% of the variation in firm performance as measured by revenue growth, operational efficiency and customer satisfaction, respectively. Further, business process automation sub-constructs were significantly associated with firm performance proxies (F= 74.693 and p=.000; F= 66.763 and p=.000; F= 73.482 and p=.000). The models thus showed goodness of fit in explaining firm performance. The intercept terms (constant) revealed that when business process automation is held constant at zero, the level of firm performance as measured by revenue growth, operational efficiency and customer satisfaction were 0.878, 0.969, and 0.676, respectively. The



regression coefficients showed track appointment system significantly affected the performance of CFS in Kenya ($\beta_1 = 0.461$, $p < 0.05$; $\beta_1 = 0.466$, $p < 0.05$; $\beta_1 = 0.422$, $p < 0.05$) as measured by revenue growth, operational efficiency and customer satisfaction, respectively. The null hypothesis (H_{01}) that *Track appointment system has no significant effect on the performance of CFS in Kenya* was thus rejected. Further, cargo handling automation had a significant effect on the performance of CFS in Kenya ($\beta_2 = 0.325$, $p < 0.05$; $\beta_2 = 0.315$, $p < 0.05$; $\beta_2 = 0.298$, $p < 0.05$) as measured by revenue growth, operational efficiency and customer satisfaction, respectively. The null hypothesis (H_{02}) that *Cargo handling automation has no significant effect on the performance of CFS in Kenya* was thus rejected. Finally, the effect of the cargo clearance system on the performance of CFS in Kenya was not significant ($\beta_3 = 0.040$, $p > 0.05$; $\beta_3 = 0.024$, $p > 0.05$; $\beta_3 = 0.121$, $p > 0.05$) as measured by revenue growth, operational efficiency and customer satisfaction, respectively. The null hypothesis (H_{03}) that *Cargo clearance system has no significant effect on the performance of CFS in Kenya* was not rejected.

Qualitative Analysis

The study further undertook qualitative analysis of interview responses to complement quantitative results by explaining the underlying reasons, meanings, and mechanisms behind statistical relationships (Fisher & Bloomfield, 2019). In this regard, the study queried the respondents on how business process automation contributed to their firm's overall performance. The interview excerpts collectively highlight the transformative role of business process automation in enhancing operational efficiency, customer satisfaction, and overall organisational performance within cargo handling and clearance facilities. The respondents consistently emphasised themes related to efficiency gains, improved service quality, enhanced financial performance, and process transparency, while also acknowledging occasional system challenges.

Theme 1: Automation and Enhanced Operational Efficiency

A dominant theme across participants' responses is the significant improvement in operational efficiency following automation. Interviewee A03 emphasised that automation has led to "improved operational efficiency" and a reduction in operational costs by 25%. Similarly, Interviewee A07 indicated that "since the introduction of automation and systems integration, we have experienced continuous growth in quantity of cargo handled per unit time," underscoring how technology has expedited processing and increased throughput. Interviewee A02 further confirmed that "automation of business processes has boosted efficiency, reduced errors, and improved customer satisfaction," reinforcing that digital tools have optimised workflow and minimised human-induced delays. Additional interviewee A12 noted, "With automated systems, we are now able to monitor cargo movement in real time and reduce turnaround time significantly." However, interviewee A09 noted, "...automation has introduced new challenges such as system downtimes and technical failures that sometimes disrupt cargo clearance operations." The finding implies that the adoption of business process automation sometimes impairs operational efficiency via downtimes.

Theme 2: Improved Customer Experience and Transparency

Business process automation was also associated with better customer experience and greater process visibility. Interviewee A01 observed that higher turnaround times have "led to more customers hence more profits," implying that faster services attract and retain clients. Similarly, Interviewee A04 stated that "web-based systems have made the clearance and compliance processes more visible and easier to track," while Interviewee A01 added that automation enables clients and customs "to communicate on the status of their consignment during clearance." Further, interviewee A13 added, "...Staff can now focus more on problem-solving and customer support instead of repetitive paperwork." These insights suggest that automation fosters real-time communication, transparency, and trust, which are essential for customer satisfaction and regulatory compliance. Despite the strong support of business process automation for customer experience, interviewee A13 noted, "...at times, customers become



frustrated when systems delay updates, reject documents automatically, or experience technical failures. “This contrary finding implies that sometimes customer experience is affected negatively by business process automation among CFSs.

Theme 3: Systemic Integration and Functional Specialisation

Respondents described various automated systems supporting specific business functions. Interviewee A03 cited the “Gate Passing system that subsists in finance” for processing requests, payments, and gate pass approvals, reflecting financial automation’s role in streamlining transactions. Similarly, Interviewee A06 referred to the use of “Pallet Loaders” and “Forklifts” for cargo handling, showcasing the integration of mechanical automation with digital tracking systems. Interviewee A02 elaborated on “virtual warehousing” for recording goods entry and exit, which aids in billing and cargo monitoring, an illustration of how technology links operational and financial processes in real time. In addition, interviewee A12 noted, “Through integrated terminal operating systems, we now have a single digital platform linking cargo receiving, customs documentation, warehousing, billing, and dispatch functions. This has eliminated the previous silo-based operations where departments worked independently with fragmented records.” The supportive responses imply that the integration of various automation technologies has improved the integration of various functions in CFSs. Despite the above responses, interviewee A07 revealed, “Functional specialisation has resulted in employees being overly dependent on narrow system-defined roles, reducing their ability to multitask or support other departments during peak congestion periods.” The contrary response revealed the extent to which business process automation may result in lowered interdepartmental coordination.

Theme 4: Efficiency as a driver of Financial and Operational Growth

The participants also associated automation with tangible financial benefits. Interviewee A01 linked growth in profits to improved service turnaround, while Interviewee A07 connected systems integration with “overall financial growth.” This correlation indicates that enhanced efficiency directly contributes to profitability through increased throughput, reduced errors, and lower operational costs. The reported 25% cost reduction (A03) further illustrates the economic value of digital transformation in logistics and clearance operations. This is a single-informant figure that was not independently verified and may not generalise across CFSs. Additionally, interviewee A08 noted, “Automated cargo tracking, digital documentation, and integrated billing systems have significantly reduced processing time and improved throughput. We are now able to handle higher container volumes with the same workforce, which has improved overall productivity and efficiency.” It was thus evident that automation, such as cargo handling automation, has been central in enhancing financial and operational growth. However, a dissenting respondent, Interviewee A09, revealed, “.... The initial investment costs for acquiring automated systems are extremely high, and ongoing maintenance expenses continue to strain our operational budget....” The finding implies that automation can also work against financial and operational growth objectives.

Discussion

The regression coefficient showed that business process automation aspects, including cargo handling automation and the track appointment system, were strongly associated with the performance of CFS in Kenya. However, the cargo clearance system weakly explained the performance of CFSs in Kenya. Although the cargo clearance system recorded the highest descriptive mean, indicating widespread adoption among CFSs, it demonstrated the weakest association with CFS performance. A possible explanation is that cargo clearance systems in Kenya have become largely standardised and mandatory due to customs and regulatory requirements enforced through the Kenya Revenue Authority and related port authorities. As a result, most CFSs may already operate at relatively similar levels of cargo clearance automation, reducing variability across firms. The findings agree with



Acemoglu et al. (2022), who established that business process automation improves organisational efficiency by reducing the need for human involvement in repetitive tasks. Similarly, Jobran and Kara (2022) showed that Automation resulted in reduced turnaround time of the ships and enhanced the equipment utilisation rate. However, the findings conflicted with those of Zebec and Indihar Štemberger (2024), who noted that Business Process Automation by itself did not directly enhance performance; it served mainly as an intermediate step in a mediated chain of influences. The results align with Systems Theory, which views business process automation among CFSs as comprised of integrated operational subsystems, including the track appointment system, cargo handling automation and customs clearance system, thereby improving coordination, minimising bottlenecks and increasing overall system efficiency (von Bertalanffy, 1968).

Although business process automation was adequately captured by its three dimensions, other dimensions, such as accounting system automation, were not in the scope of the study. As such, the coefficients should be interpreted with caution, as the addition of more sub-constructs may result in a change in the magnitude and direction of effects. Additionally, the current study was situated within CFSs in Kenya, which may restrict the applicability of the findings to other organisational contexts, such as state-owned enterprises and manufacturing companies. Another limitation of this study relates to the potential non-independence of observations arising from the use of multiple managerial respondents from the same CFSs. Although the study adopted anonymous data collection procedures to enhance confidentiality and encourage candid responses, respondents were not required to indicate their specific firms. Consequently, firm-level identifiers necessary for clustered standard error estimation or multilevel modelling were unavailable during analysis. The study, therefore, treated managerial responses as independent observations, which may have resulted in some degree of inflation in the reported t-statistics and statistical significance levels due to unobserved intra-firm correlation. Future studies should incorporate anonymised organisational codes to facilitate hierarchical or clustered analytical techniques capable of accounting for nested data structures.

Conclusion

The study sought to determine the effect of business process automation on the performance of container freight stations in Kenya. Business process automation sub-constructs, such as cargo handling automation and the track appointment system, were positively associated with operational efficiency, revenue growth, and customer satisfaction among CFSs in Kenya. The CFS operators are advised to invest in automated cargo handling technologies, such as barcode and RFID scanners, automated container stacking cranes, and digital inventory management systems. By implementing these innovations, CFSs may minimise human errors, accelerate container retrieval operations, and enhance warehouse space efficiency. From a policy standpoint, Kenya Ports Authority (KPA) and the Ministry of Transport should focus on the provision of specific incentives, including tax reductions, subsidised digital infrastructure, or access to low-interest loans for small- and medium-sized CFS operators to implement automated systems. Additionally, regulatory frameworks should encourage interoperability standards and seamless data exchange among CFSs, ports, customs authorities, and freight forwarders, ensuring that automated processes such as cargo tracking, clearance, and handling are coordinated and efficient.



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