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The Influence of the Implementation of Trade Facilitation Systems on the Time Required for Creating Delivery Orders: A Case Study of Tema Port

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Abstract

This study evaluated the impact of Ghana's Integrated Customs Management System (ICUMS), implemented within the National Single Window initiative, on the efficiency of issuing Delivery Orders (DO) at Tema Port. Filling a gap in the existing literature, the research employed a quantitative approach to assess a specific time-related aspect of the cargo clearance process. Employing an Independent t-test on a dataset spanning 2026 Delivery Orders (924 pre-ICUMS and 1102 post-ICUMS) from July 2020 to July 2023, the study investigated ICUMS's effectiveness in reducing DO issuance time. Results indicate a noteworthy decrease in average DO issuance time, from 11 days pre-implementation to approximately 9 days post-implementation, a reduction validated by statistical analysis through the independent t-test. In light of these findings, the study recommends ongoing refinement of the implementation, reinforcement of trade facilitation measures, and the adoption of best practices from successful global ports. Continuous stakeholder training and regular assessments of ICUMS performance are also endorsed. The study's implications support the theoretical framework for Single Window systems and carry significant policy implications, emphasizing the need for collaborative efforts to streamline trade facilitation processes driven by Information Technology. Practically, the results serve as a management tool for stakeholders, highlighting areas for targeted interventions to reduce DO issuance times. Methodologically, this research contributes by applying robust statisti-

cal analysis to a specific component within the Time Release Study framework, offering a nuanced understanding of trade facilitation systems' effectiveness in improving cargo clearance processes.

Keywords

Cargo Clearance, Container Dwell Time, Single Window, Trade Facilitation

1. Introduction

The drive towards enhancing trade facilitation through the implementation of Single Window systems has been a significant focus for many countries since the introduction of the International Convention on the Simplification and Harmonization of Customs Procedures (Kyoto Convention) [1]. As noted in [2] [3], these initiatives are geared towards simplifying, harmonizing, and modernizing customs procedures to bolster international trade, a mission underscored by the United Nations Economic Commission for Europe [4]. The UNECE describes a single window system as a mechanism that enables traders to submit all necessary information for import and export to a single entity, thereby streamlining regulatory requirements. Globally, there have been several noteworthy implementations of such systems, including the Association of Southeast Asian Nations (ASEAN), Singapore's TradeNet, and Asycudaworld, which has found applications in over 102 countries, including several African nations like The Gambia, Cote d'Ivoire, and Malawi.

Ghana's journey towards trade facilitation began in the 1990s, bolstered by support from international entities like the World Bank, the United States, and the International Monetary Fund. This period saw the rise of the Ghana Community Network (GCNet) and the Ghana Integrated Cargo Clearance System (GICCS), drawing inspiration from Singapore's TradeNet [5]. Additionally, West Blue Consulting played a pivotal role in developing Ghana's first strategic action plan for a National Single Window (GNSW). The coexistence of GCNet and West Blue Consulting eventually gave way to the current system, the Integrated Customs Management System (ICUMS), implemented by Ghana Link Network Services Limited on behalf of Ghana Customs. This system, representing a significant leap in trade facilitation, was introduced to overcome the shortcomings reflected in Ghana's dip in the World Bank's Ease of Doing Business Index from 60.4 in 2019 to 60 in 2020 [5] [6].

In contrast to previous assessments that have largely concentrated on Container Dwell Time (CDT) and Revenue Generation, our study shifts the focus to a less explored, yet critical aspect of the trade facilitation process—the time taken from the completion of container discharge to the submission of the Delivery Order (DO) for release at Terminals or Inland Container Depots (ICD). This investigation is particularly timely, occurring three years after the implementation of ICUMS, to evaluate its effectiveness in improving this specific compo-

nent of the cargo clearance process at Tema Port.

In our study, we delve into the extensive literature surrounding Trade Facilitation (TF) systems, particularly focusing on the impact of these systems on the time it takes to create a Delivery Order. The World Customs Organization emphasizes the importance of TF as a process of simplifying, modernizing, and harmonizing export and import processes to streamline international trade [7]. A significant aspect of this facilitation has been the implementation of Single Window (SW) systems, as defined by UN/CEFACT Recommendation 33. These systems allow for a more efficient lodging of information and documents at a single-entry point to meet all regulatory requirements for import, export, and transit.

Globally, the adoption of SW systems has been widespread, with notable examples in Singapore (TradeNet), Sweden (Virtual Customs Office), the UK (UK International Trade Single Window), and several countries in Africa including Ghana with the GCNet system [3]. The benefits of these systems have been well documented, with studies highlighting their positive impact on reducing the cost of doing business, increasing revenue, and reducing fraud [8]-[11]. However, despite these successes, there has been a notable gap in the literature, particularly regarding the measurement of specific time-related factors in the clearance process, such as the time to issue a Delivery Order.

Previous studies have often leaned towards qualitative methodologies, relying heavily on respondents' opinions, and potentially overlooking critical quantitative aspects [3]. While these studies have provided valuable insights into factors like terminal capacity and equipment availability [12]-[18], they have generally neglected the quantification of time taken for key processes like Delivery Order issuance. This gap is especially significant in light of the World Customs Organization's recommendations for Time Release Studies (TRS) as a means to evaluate trade facilitation performance, focusing on the time taken by Customs to release consignments [19].

Countries like Malawi and The Gambia have implemented TRS, leading to recommendations for more integrated computerized systems and enhanced port operations [20] [21]. However, these studies still fall short of applying robust statistical analyses to specific time components within the TRS framework. Our study aims to fill this methodological void by applying an independent t-test to evaluate the impact of Ghana's national single window, ICUMS, on the time it takes to receive a Delivery Order. This approach not only contributes to the existing body of literature but also provides a more nuanced understanding of the effectiveness of trade facilitation systems in improving specific aspects of the cargo clearance process.

2. Methodology

In our study, we employed a rigorous methodology to assess the impact of the Integrated Customs Management System (ICUMS) on the time taken to create a Delivery Order at Tema Port. Central to our approach was the use of the Inde-

pendent T-Test, a parametric statistical tool, applied to a significant sample size of 2026 Delivery Orders. This dataset was comprised of 924 Delivery Orders created by ship agents before the implementation of ICUMS and 1102 created after its implementation, spanning from July 2020 to July 2023.

Following the methodology outlined by [22], our process began with the meticulous collection of data, which was then subjected to thorough cleaning to ensure accuracy and reliability. An exploratory data analysis was conducted next, where we scrutinized the data to identify any outliers that could skew our results. A crucial step in our methodology was the normality test, which helped us assess whether the data distribution met the assumptions required for applying the Independent T-Test.

With the data prepared, we then categorized it into two main groups: "Before ICUMS" and "After ICUMS." This clear demarcation allowed us to precisely measure the impact of ICUMS on the Delivery Order creation process. We formulated our hypotheses based on the expected outcomes of ICUMS implementation, which then guided our analysis.

The analysis phase involved applying the Independent T-Test to these two distinct data sets. This statistical approach was instrumental in determining whether there were any significant differences in the time taken to create a Delivery Order before and after the implementation of ICUMS.

Interpreting the results was a critical step where we translated our statistical findings into meaningful insights, understanding the real-world implications of our data. Finally, we concluded our study by drawing comprehensive conclusions based on the evidence gathered, thereby providing a nuanced understanding of the impact of ICUMS on trade facilitation at Tema Port. This methodical approach not only lent credibility to our findings but also ensured that our study could be a valuable contribution to the ongoing discourse on the effectiveness of trade facilitation systems. (**Table 1**)

Table 1. Description of data and variables.

SN	Name of Variable	Description	Data Type
1	Discharge Completion Date	The date and time the stevedore company completes the discharge of all cargo on the voyage	TimeStamp
2	Delivery Order Date	The date and time the Delivery Order is created by the ship agent	TimeStamp
3	Before	The number of days it took each DO to be created before the implementation of ICUMS	
4	After	The number of days it took each DO to be created after the implementation of ICUMS	

Hypothesis

The main hypothesis underpinning this test is stated below:

H_0: $\mu_{\text{before}} \neq \mu_{\text{after}}$ (The mean of the before sample is not the same as the mean of the after sample)

H_1: $\mu_{before} = \mu_{after}$ (The means of the "Before" and "After" samples are the same)

Where H_0 and H_1 represent the null and alternative hypotheses respectively

Test Statistic

The test statistic of the independent t-test is represented by:

$$t = \frac{\bar{X}_{before} - \bar{X}_{after}}{Se}$$

where: t = t statistic, $\bar{X}_{before}, \bar{X}_{after}$ = the "Before" and "After Samples", Se = Standard Error of mean.

3. Results

Our study, encompassing a comprehensive analysis of 2026 observations, provided insightful results on the impact of the Integrated Customs Management System (ICUMS) on the time taken to create a Delivery Order at Tema Port. The data was divided into two groups: before and after the implementation of ICUMS. The "Before" group, consisting of 924 observations, had an average time of 11 days to create a Delivery Order with a variance of 88.09 days. In contrast, the "After" group, comprising 1102 observations, showed a reduced average time of 9.22 days and a markedly lower variance of 19.34 days.

These descriptive statistics, detailed in Table 2, initially indicated a reduction in the average time to create a Delivery Order post-ICUMS implementation. However, the critical question was whether this difference was statistically significant. This query was visually supported by Figure 1, which depicted a generally lower and smoother trend line for the "After" group (in green) compared to a higher and more variable line for the "Before" group (in red).

Table 2. Descriptive statistics of the two groups.

Statistic	Before	After
Observations	924	1102
Mean	11.00	9.22
Variance	88.09	19.34

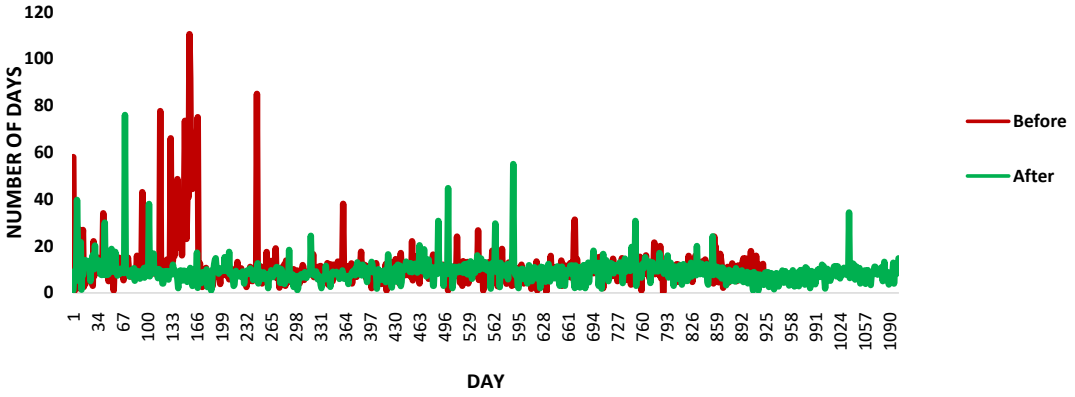

Figure 1. Descriptive statistics of the two groups.

To address this significance question, we conducted an independent t-test, the results of which are presented in Table 3. The test compared the "Before" group (mean = 11.00 days, SD = 9.38) with the "After" group (mean = 9.22 days, SD = 4.39). The findings were striking: the post-ICUMS group demonstrated significantly reduced days to create a Delivery Order, with a t-statistic of 5.31 and a p-value of approximately 0.000000129.

Table 3. Output statistics of the independent t-test.

Statistic	Value
Hypothesized Mean Difference	0
df	1258
t Stat	5.31
P (T ≤ t) two-tail	1.29E−07
t Critical two-tail	1.96

Given these results, we rejected the null hypothesis, which posited no difference in the mean days to create a Delivery Order between the two groups. The statistical significance of these findings strongly suggests that the implementation of ICUMS at Tema Port has had a meaningful impact on reducing the time required to create a Delivery Order, a key factor in the cargo clearance process. This evidence highlights the efficacy of ICUMS in improving trade facilitation at Tema Port, marking a significant step forward in the port's operational efficiency.

4. Discussions

The literature consistently highlights the benefits of implementing Single Window (SW) systems and Trade Facilitation (TF) platforms, pointing to their widespread adoption worldwide [3]. Our study aligns with these findings, demonstrating the positive impact of the Integrated Customs Management System (ICUMS) on the time taken to issue a Delivery Order (DO) at the Port of Tema. Prior to ICUMS, the average time from container discharge completion to DO creation was around 11 days, which was reduced to approximately 9 days post- implementation. This improvement, though significant, suggests there's still potential for further enhancement.

This achievement can likely be attributed to various trade facilitation measures introduced alongside ICUMS. These include the introduction of Pre-Manifest Declarations, which allow for earlier submissions of declarations, even before ship manifests are submitted to Customs. Simplification of the payment regime and expansion of payment methods to include Visa, mobile apps, Mobile Money, and Internet Banking, alongside improved grievance management systems, have also played a role. Additionally, the implementation of a user-friendly system and a common platform for inspection and offense treatment by Customs, coupled with the onboarding of all stakeholders in the clearance chain, have col-

lectively contributed to speeding up the clearance process.

Given the direct link between Container Dwell Time (CDT) and the cargo clearance process [23], it is expected that the reduction in DO issuance time would correspondingly lead to a decrease in the average CDT. While this progress is commendable and would have positively impacted Ghana's ranking in the World Bank's Ease of Doing Business Index (had it not been discontinued), there is still considerable room for improvement. Internationally, many ports and terminals report a CDT of under 5 days [24], highlighting that a 9-day DO lead time, although reduced, is still relatively high. Particularly in Africa, where interventions including the implementation of trade facilitation strategies have brought the average CDT down to 4 days, the current situation at the Port of Tema indicates that after the issuance of a DO, several more days are typically required for terminal processes to complete and for consignments to be released. This context emphasizes that while the strides made in reducing DO issuance time are a step in the right direction, achieving a more streamlined and efficient cargo clearance process remains an ongoing challenge that requires continued attention and improvement.

Theoretically, the findings of this study affirm the theoretical framework established by the United Nations (UN) for the implementation of Single Window (SW) systems within SW environments. The pivotal recommendations outlined in [25] include the initial proposal for the development of a framework and guiding principles for SW implementation, followed by the subsequent guidelines [26], and culminating in the latest revised guidelines [27]. These recommendations highlight the importance of a unified authority, a single system, and automation to improve trade-related outcomes such as efficiency in time management. In terms of the study's implications on policy, practice, and the social aspects of life, it is expected that an awakening would lead to drastic measures that would reduce the burden of delays thereby reducing the cost of doing business in the ports of Ghana.

5. Recommendations

Based on the conclusions of our study, several recommendations emerge for enhancing the efficiency of the cargo clearance process at the Port of Tema, particularly in the context of the Integrated Customs Management System (ICUMS) implementation. First and foremost, it is recommended to continue refining and improving ICUMS. While the system has already reduced the average time to issue a Delivery Order (DO) from 11 to approximately 9 days, there is still potential to achieve further reductions. This could involve enhancing the system's features, improving user interfaces, and ensuring that it integrates more seamlessly with other systems used by stakeholders in the clearance chain. Furthermore, it is advisable to expand and deepen the range of trade facilitation measures that accompany the use of ICUMS. Building on the success of initiatives like Pre-Manifest Declarations and the diversification of payment methods,

additional measures could focus on further simplifying documentation requirements, enhancing transparency in the clearance process, and streamlining inter-agency coordination. These measures would not only expedite the DO issuance process but could also have a ripple effect in reducing the overall Container Dwell Time (CDT).

Given the significant room for improvement in comparison with international standards, where many ports report a CDT of under 5 days, the Port of Tema should aim to benchmark its performance against these global standards. This could involve studying best practices from other successful ports and adapting these strategies to the local context. Additionally, it is important to engage in continuous training and capacity building for all stakeholders involved in the cargo clearance process. Educating users on the most efficient ways to utilize ICUMS and ensuring they are fully conversant with all its functionalities can significantly reduce delays.

Lastly, it is recommended to conduct ongoing evaluations and research. Regular assessments of ICUMS performance and the overall cargo clearance process can help identify bottlenecks and areas for further improvement. This should include soliciting feedback from users to ensure that the system evolves in line with the needs and challenges of the trade environment.

6. Conclusions, Limitations and Future Research Direction

The primary conclusion of our study centers on the significant impact of the Integrated Customs Management System (ICUMS), Ghana's version of the National Single Window, on the time required to issue a Delivery Order (DO). The independent t-test conducted to explore this impact revealed a noteworthy outcome: the implementation of ICUMS in 2020 has markedly reduced the average time to obtain a DO. Prior to ICUMS, the average time stood at approximately 11 days, which significantly decreased to around 9 days following the implementation of this system.

These findings are more than just numbers; they underscore the tangible benefits of embracing technological advancements and streamlined processes in trade facilitation. The reduction in DO issuance time, while significant, also opens the door for further improvements. This study suggests that the current implementation of ICUMS has been effective, but there is potential to enhance its efficiency even more. By continuing to refine and develop ICUMS, there is a promising possibility to further decrease the lead time for DO issuance.

In essence, our study not only affirms the positive impact of ICUMS on trade facilitation at the Port of Tema but also highlights the importance of continuous improvement in such systems. It is a call to action for stakeholders involved in trade facilitation and customs processes to not only maintain the current level of technological and procedural advancements but also to seek ways to further optimize these systems. This ongoing effort is crucial for ensuring that the Port of Tema remains competitive and continues to improve its efficiency, ultimately

contributing to smoother and faster trade processes.

In acknowledging the limitations of our study and outlining directions for future research, it's important to recognize that while our findings provide valuable insights into the impact of the Integrated Customs Management System (ICUMS) on the time taken to issue a Delivery Order (DO) at the Port of Tema, they are not without constraints.

One key limitation is the scope of the data. The study's timeframe could be too short to fully capture long-term effects or sustainability of ICUMS implementation on port operations. Sole reliance on quantitative data may overlook nuanced operational or contextual factors affecting DO issuance times. Again, there is limited examination of how DO issuance time reductions translate to broader economic benefits for Ghana or implications for international trade. Future research could benefit from incorporating qualitative methods, such as interviews or focus groups with stakeholders. This approach would provide a more nuanced understanding of the user experience with ICUMS, identifying potential areas for improvement that may not be evident from quantitative data alone.

Another limitation is the study's focus on a single port. While the Port of Tema is significant, examining the impact of ICUMS in other ports in Ghana or comparing it with similar systems in other countries could offer a broader perspective on the effectiveness of such trade facilitation systems. Furthermore, our study did not extensively explore the relationship between DO issuance times and broader economic or logistical impacts. Future research could investigate how reductions in DO issuance times influence overall trade volumes, economic efficiency, and customer satisfaction. Lastly, the rapidly evolving nature of trade facilitation technology and changing global trade dynamics suggest the need for ongoing research in this area. As new technologies and practices emerge, continuous evaluation of their impacts will be essential for ensuring that trade facilitation systems like ICUMS remain effective and relevant.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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