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Improvement of Business Processes on Custom Clearance for International Logistics Companies

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Abstract This study examines the improvement of customs clearance business processes for international logistics companies within the context of global supply chains. Inefficiencies in traditional customs clearance, characterized by bureaucratic delays, fragmented procedures, and limited technological integration, continue to undermine logistics performance, raise operational costs, and pose security risks. To address these challenges, the study adopts a process-oriented and technology-driven perspective grounded in Business Process Re-engineering (BPR) and Systems Thinking theory. Using document analysis, business process modelling (BPMN), and logistic regression analysis, the study compares the traditional clearance model with the proposed improved model. Findings reveal a substantial performance improvement, with clearance efficiency increasing from 40% under the traditional system to 88% under the redesigned, technology-enabled process. The results demonstrate that systematic process re-engineering combined with integrated digital technologies can significantly reduce clearance time, minimize bottlenecks, and strengthen both trade facilitation and regulatory control. The study contributes a practical and scalable model for policymakers, customs authorities, and international logistics firms seeking to enhance cross-border logistics performance in developing and emerging economies.

Keywords: *Customs clearance, International logistics, Business process re-engineering, Systems thinking, Web of things*

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1. Introduction

Global supply chain is rapidly becoming more effective in defining the competitiveness of economies, customer satisfaction, and the ability to withstand pressure from international trade systems (Siagian et al., 2024). International logistics companies are at the center of this process, operating as the working interface between the producers, the marketers, and consumers across national borders. With the increasing volumes of trade and rates of timely delivery demands, the efficacy of the transport of products across borders is no longer an auxiliary operational matter but rather a primary determinant of business survival and competitiveness (Arvis et al., 2023). Any failure in this chain, especially at the border control points, has

immediate cost, time, and reputational implications to logistics companies and their customers. Despite improvements in transport technologies and trade facilitation programs, the process of customs clearance remains one of the most problematic and critical points in international logistics operations. The customs clearance is the gateway through which the goods enter or leave the national economies, and thus it is a decisive factor whether the supply chains will run smoothly or congestion will occur due to the administrative delays (Oni, 2023). The long clearance periods, bottlenecks within the bureaucracy, and lack of consistency in the implementation of procedures, however, still face many firms in practice. It is proven that the goods can stay at ports for weeks or even months before receiving approval and be spoiled, damaged, or even lost (Chinedum, 2018; Rana, 2019; Rachidi & Touhami, 2022; Rebs et al., 2019). Although these studies eloquently record the presence and the impact of delays, they, to a large extent, accept prolonged port dwell time to be an effect and do not critically analyze the underlying business process structure, decision points, and institutional relationships that systematically create such delays. Consequently, there is no evidence of long periods of clearance that are empirically associated with certain operational or process-level failures of international logistics firms.

According to Karklina-Admine et al. (2024), research on the issue of customs clearance has been conducted in the past and includes records of the challenges faced, with most of the available literature being descriptive, and thus, it presents delays and inefficiencies with no structured process-based solution. More precisely, available research is limited to examining generalized inefficiency, regulatory burden, or administrative delay without much focus on end-to-end process mapping, cross-institutional coordination, and integrating digital capabilities into the processes of customs clearance. This forms a research gap in analytically based, process-based models of how and where inefficiencies arise and of how they can be intelligently reformulated. It is on this background that this study is not only necessary but also timely. It goes beyond problem identification to critically assess current customs clearance practices and suggest an improved business process model that would streamline the operational reality of the international logistics companies.

This research is aimed at achieving three objectives. First, it explores the current customs clearance practices and defines the major operational challenges confronted by the international logistics companies, with a specific focus on the process inefficiencies leading to delays and higher costs. Secondly, it follows a process-based and technology-intensive methodology to assess how the integration of digital tools, institutional programs, and coherent regulatory mechanisms can simplify operations in customs clearance and increase efficiency and transparency. Third, it suggests a better business process design of customs clearance to provide practical and actionable suggestions to the customs authorities and global logistics companies to trim down the clearance time, reduce the number of bottlenecks in the operations, and enhance the overall performance of the cross-border logistics operations.

2. Theoretical Framework

This paper integrates Business Process Re-engineering (BPR) and Systems Thinking within a logical analysis. Each theory plays a specific yet complementary role in the research design. BPR serves as the methodological driver. It helps identify key processes, select performance-based variables, and guide process redesign to improve efficiency and effectiveness. Systems Thinking is the general epistemological prism. It views the organization as a connected system, where redesigned processes interact through feedback loops, interdependencies, and contextual constraints. In this context, BPR's focus on process-level change shapes data selection. Model building and interpretation follow Systems Thinking principles, emphasizing systemic coherence and dynamic interactions. Findings validation goes beyond individual process results. It analyzes system-wide outcomes to show how process improvements relate to organizational and sustainability consequences. This combined methodology offers a single analytical framework for studying organizational change, surpassing parallel theoretical accounts.

2.1. Business Process Re-Engineering (BPR)

Business process modeling is merely the art of drawing and explaining how things are accomplished in a company step by step so that issues can be observed and resolved (Dumas et al., 2018). In customs

clearance, it demonstrates the way documents are presented, verified, accepted, and released, which makes it simpler to determine the reasons why goods are held up and how the process may be enhanced. BPR, on the other hand, was introduced as a management strategy by Hammer and Champy in 1993. The authors contended that the approach relies on significant changes to basic business processes to improve productivity, efficiency, effectiveness of services, and quality. They further stressed that, rather than requiring small updates, BPR proposes that a system should be scrutinized and rebuilt from the ground up. BPR relies on the belief that most company processes are old-fashioned, scattered, and restricted by outdated ways or structures. Attempting to realign these processes in line with current demands is done mainly by adopting IT and automation (Popoola et al., 2024).

Recent research has noted that the inefficiency in customs processes has remained constant, with many layers of manual checks, paperwork, and agency siloed operations delaying the passage of goods (Justice et al., 2025; Nurisnaeny et al., 2024). The remedy of BPR is that it proposes the total transformation, rather than the automation of these workflows. The redesign will involve the integration of digital technologies, the elimination of unnecessary processes, and the development of collaborative systems among the various actors in the clearance chain. This paper views integration as an end-to-end setup that explicitly connects process activities, decision points, information flows, inter-agency coordination processes, and performance measures within one analytical and operational framework. This definition is used as the basis for evaluating limitations in prior BPR-related customs studies.

A study by Rebs et al. (2019) revealed that the customs procedures practiced in West Africa were mainly responsible for delays and damaged products. It suggested that governments and logistics businesses should apply BPR methods, change the way they clear goods, rely on advanced platforms, and improve how agencies interact. Although the research recognizes delays and suggests BPR and advanced platforms, it fails to create and empirically examine an integrated and actual business process model of customs clearance that can be operationalized by logistics companies and customs authorities. In particular, the restriction of Rebs et al. is conceptual and empirical: conceptually, the process of redesigned BPR is not brought into a single unified process architecture; empirically, the processes under redesign are not proven by quantifiable performance metrics like clearance time, coordination efficiency, or reduction of damage.

Similarly, Kimai's (2018) work, commonly referenced in post-2019 literature, revealed that the customs departments in East Africa made use of information technology to lower their clearance times and increase efficiency. The primary emphasis here was on connecting BPR with technology to achieve easy posting of documents, use of electronic signatures, and real-time dialog with other partners. The study illustrates the advantages of IT implementation in the context of minimizing the clearance time, but is very narrow in its scope, modeling the interaction between technology and business process redesign in a single customs clearance process. This is a technical constraint since integration is considered to be synonymous with digitalization, not to redesign system-wide processes across agencies. Viewing technology adoption as equivalent to effective BPR would be tantamount to technological determinism, a weakness that the study will not assume by adopting technology as an enabler and not the heart of re-engineering.

More so, a similar investigation was carried out by Chinedum (2019), highlighting some of the inefficiencies faced at Nigerian ports. The author found that poor clearing procedures are costly and that delays can result in paying for storage, extra charges, and damaging a logistics firm's reputation. The paper suggested an approach to BPR that combines removing unnecessary steps, aligning policies, and automating processes to improve competitiveness. The work records the inefficiencies and suggests general principles of BPR, but does not go further to formalize a structured and end-to-end process model that could measure performance gains in customs clearance operations. In this way, the contribution is diagnostic and not analytical since no systematic process structure or validation model is presented to determine system-wide benefits of redesign.

In an expanded study, Lebid et al. (2021) focused on the efficiency of simplification of customs formalities on a digitalization basis by comparing regulations across various jurisdictions. They pointed out that it is not only difficult to unify policies, but it is also important to change internal procedures. They discovered that by bringing together clarity of clearances, databases, and procedures using the

online services, they alleviate the tension on various national agencies. When countries use electronic data interchange and share data instantly, it makes it much easier for different border agencies to cooperate, speeds up their work, and reduces costs (Justice et al., 2025). Although the study highlights digital harmonization and regulatory simplification of jurisdictions, it fails to apply these lessons to a business process model that reflects the business realities of international logistics firms. This is an institutional, and not operational, limitation, as the alignment of regulation is talked about without modeling the interaction between logistics companies and customs authorities in the context of a single clearance workflow.

Nurisnaeny et al. (2024) focused on how Artificial Intelligence (AI) is used in maritime border patrols at Sebatik Island in Indonesia. They discovered that, for successful implementation, the following three things were necessary: ready infrastructure, smooth operations, and enough human resources. They recommended that, during AI adoption, predictive technologies should be used, efforts should be made to protect local knowledge networks, and that both national and regional needs must be met. The paper points to the conditions under which the adoption of AI in maritime border patrols can be successful; however, it lacks an analysis of the integration of AI-based tools into the daily customs clearance operations, especially in the logistics-based clearance operations.

Furthermore, Baiyere et al. (2020) focused on digital transformation and the new logic of business process management. They discovered how BPR can be used as part of the digital transformation of logistics and argue that companies usually fail because they transform existing problems without changing the way things are done. Through their submission, BPR is necessary for accomplishments related to shipments, business regulations, and communicating with customers. However, some of these studies do not consider remote geographies where efficient operation of certain technologies may be limited by a factor of poor network and internet connection, especially in some Sahel African regions. More so, despite emphasizing the importance of BPR in digital transformation, the study does not account for contexts with limited digital infrastructure or propose complementary institutional programs to support process efficiency in regions with poor network connectivity.

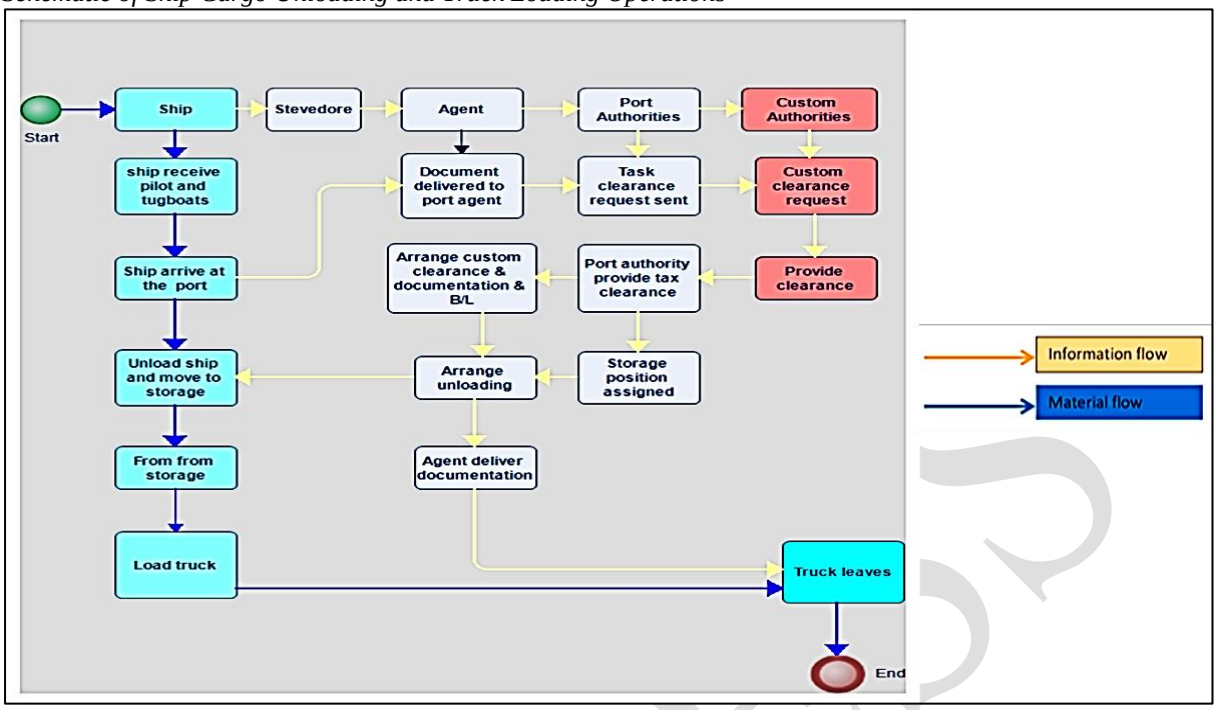
Rana (2019) notes that cargo containers are brought to the port by trucks (Figure 1). A port agent of the firm must organize customs clearance, pay port taxes, and prepare the requisite paperwork, including a Bill of Lading, before cargo containers can be unloaded or loaded onto a ship. It is also the one that organizes the loading of the cargo on the ships. Once these processes are completed, cargo is loaded onto the ship, and it departs the port for another country or continent. Despite a very elaborate operational analysis of port clearance activities and an identification of the main sources of delay, the study is silent on a proposed redesigned technology-enabled process of customs clearance, which effectively reduces handoffs and streamlines information flows and generally increases the overall clearance performance.

These studies together shed some light on the key inefficiencies, but are in a disjointed form, each one of them concentrating on technology, regulation, or an isolated stage of the process. None of them builds an empirically testable integrated business process model that coordinates workflows, technologies, decision rules, and performance measures between agencies. The current research fills this gap by introducing a theoretically-based BPR model, which is anchored in a systems view, operationalizing the concept of integration, and allowing the empirical assessment of the performance of customs clearance. The core operations that have to be addressed, as defined by Rana (2019), are:

- Limited berths increase ship waiting times, raising port congestion and overall ship turnaround time.
- Shortage of loading/unloading equipment, such as gantry cranes, extends ship time at the port.
- The delay of trucks at the port generates fluctuation in the time of unloading cargo, thus decreasing operational efficiency.
- Good unionization and stevedore labor practices make cargo handling slow and are a source of delays in loading and unloading.

Figure 1

Schematic of Ship Cargo Unloading and Truck Loading Operations



Note. Adopted from the work of Rana (2019).

The above literature emphasized the role of BPR in positively transforming customs clearance and the shortcomings or gaps that this study seeks to fill. The point of the approach is not to hurry up processes but to review how work is carried out, who performs it, and which technologies are needed. Among these, having teamwork, active commitment from organizations, and the right technology and people are important.

2.2. Systems Thinking Theory

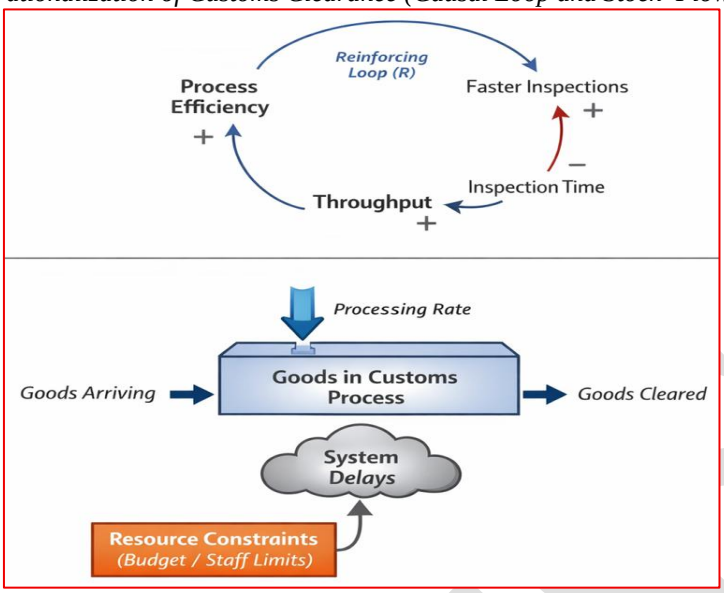
This theory was invented by Forrester in the 1950s. The theory implies that customs clearance processes are clearer if we focus on the relationships and dependencies of the different system parts. It addresses how separate areas of activity, distinct from one another, can still be connected (Albakri & Wood-Harper, 2025). It can be applied to understand how the interactions of authorities, importers, freight forwarders, software systems, and regulators influence how well customs clearance is carried out. When paperwork is not checked within a proper time range, it causes more difficulty and expense for everyone down the line.

Empirical data indicate that using Systems Thinking in customs makes a big difference; according to Allende (2022), a 2022 World Customs Organization (WCO) study found that sharing and analyzing data helped countries cut down on customs clearance time, and there was more transparency. However, critics believe that Systems Thinking is hard to apply when resources are scarce and may not consider how politics and inertia play a role (Albakri et al., 2025; Reynolds, 2024).

The Systems Thinking operationalization in Figure 2 consists of clearly modeling feedback loops and system dynamics in the process of customs clearance. The top section shows a reinforcing feedback loop (R) where the increased efficiency of the process causes improved inspections, higher throughput, and additional efficiency, resulting in performance improvements that may compound over time. Inspection time also implies a balancing loop, whereby it limits the speed of inspection and does not allow a wild romp, since the real world has regulatory and capacity limits to unreasonable acceleration.

Figure 2

Systems Thinking Operationalization of Customs Clearance (Causal Loop and Stock–Flow Representation)



Note. Conceptual Causal Loop and Stock-Flow Model.

These relationships are converted at the lower part to the stock structure of a stock-flow model, with "Goods in Customs Process" being the system stock, which is affected by inflows into the system (goods arriving) and outflows (goods cleared). The processing rate is in control of the speed of goods passing through the system, and system delays arise due to constraints of resources like staff and available budget. The diagram addresses this criticism that Systems Thinking is challenging to implement when resources are scarce by explicitly modeling these constraints and demonstrating the impact of constraints on the behavior of a system and clearance performance. The causal loops, along with the stock- flow structure, show the dynamic interaction between feedback and delays and constraints, and hence offer an analytical basis for the proposed customs clearance model.

3. Methodology

The research assumes a hybrid analytical design, where Systems Thinking guides model design and relationships of variables, and statistical learning methods are employed in evaluating comparative performance of alternative clearance process designs. The paper employed this approach for these reasons. It evaluates the systematic thinking step-by-step approach in this paper to develop the proposed business process model. The study employed a statistical learning approach (logistic regression analysis) to evaluate the comparative performance of alternative clearance process designs. Based on this, a new model is recommended for practitioners.

3.1. Materials

This research is based on documentary and archived resources as opposed to interviews or questionnaires, where respondents can skew responses to suit their narrative. The documents considered as sources of data are official records, technical reports, policy documents, system manuals, port authorities, logistics companies, international organizations, and performance evaluation reports that have been published in the recent years, 2015-2024. These materials have been chosen on purpose, in order to include pre-digital as well as digitally enabled customs clearance regimes. The use of documentary materials is methodologically justified for three reasons. First, clearance is a very controlled and procedurally standardized process; documents are the most authoritative and stable sources of information about the official arrangement of clearance operations, their structure, order, and implementation. These documents will record institutional practice instead of subjective perceptions, so they will be appropriate to recreate clearance processes and find out the logic of processes. Second,

key actors in the ecosystem of customs clearance, including customs authorities, port operators, regulatory agencies, logistics and freight forwarding companies, customs brokers, and information system administrators, have key roles, responsibilities, and interactions that are clearly outlined in procedural standard operating manuals and regulatory texts. Such materials allow visualizing the interrelations, handoffs, and coordinating mechanisms that lie at the heart of Systems Thinking analysis but are not easily described with the help of survey-based tools. Third, documentary sources offer believable, non-reactive information about time-based institutional performance, including inspection procedures, clearance schedules, reports of congestion, and compliance processes. Such characteristics can be mechanically derived and converted into measurable values and, hence, allow an empirical comparison of different clearance process configurations.

It is important to note that the analysis does not, however, consider documentary sources as direct measures of actual operational performance; they are made to replicate institutionally described process structures and constraints, with the quantitative analysis being a comparative assessment of other possible system designs and not an anticipation of the observed transactional results. Structured content analysis was used in order to operationalize the documentary evidence. Attributes of the process mentioned in multiple documents, including the frequency of inspection, documentations, number of agency contacts, use of digital platforms, the duration of clearance, and the frequency of rework, were identified, coded, and converted into variables that could be analyzed. This transformation made it possible to reconstruct the end-to-end customs clearance process and give the empirical foundations for further background in quantitative modelling.

3.2. Procedure

The research follows an analytical process that is guided by Systems Thinking to study and redesign the customs clearance processes of international logistics operations. Systems Thinking is utilized as a structuring logic since it focuses on customs clearance as an interconnected structure of activities, information flows, decision points, delays, and feedback mechanisms instead of operational tasks in isolation.

The first stage involved reconstructing the existing (traditional) clearance process using documentary materials. The important process characteristics were extracted and coded into quantitative variables of a systematic review of documents through explicit coding rules. There were three encoding schemes used: *Binary variables* were used where documents indicated the presence or absence of a process feature. As an illustration, the presence of electronic submission systems (EDI-based vs. manual submission), the presence of automated screening of risks, or the presence of an integrated system of inspection was coded as 1 (present) or 0 (absent). *Ordinal variables* were employed for attributes described in documents using graded intensity or frequency. The intensity of inspection, the degree of inter-agency interaction, and the complexity of documentation were measured using the ordered scale (e.g., low = 1, medium = 2, high = 3), according to the criteria that were always based on regulatory thresholds and working standards. Process performance indicators were categorized as continuous proxies. *Continuous variables* (e.g., hours/days, counts) were the clearance duration, number of process steps, number of agency handoffs, and frequency of rework. In cases where documentation was not of the exact values but of ranges, they were estimated at the mid-value or on a standard basis to ensure empirical plausibility. This encoding plan meant that qualitative procedural accounts were accurately coded into machine-readable datasets without any loss of the meaning structure of the original documents. The Systems Thinking constructs, particularly stocks (e.g., goods in clearance), flows (processing rates), delays (inspection and approval lags), and feedback loops (rejections and resubmissions) guided the selection and grouping of variables.

Two comparison data sets were created. The conventional clearance data set is a baseline process parameter based on the existing clearance practices written down. The enhanced clearance dataset is a reconstructed layout that is based on the principles of BPR and Systems Thinking logic, including fewer handoffs, better coordination, digital verification, and limited feedback delays. Such sets are not actual transaction records but a priori records founded on the documented operational parameters. Multiple clearance instances were generated by varying key encoded variables within realistic bounds identified

in the documentary sources. This is a scenario-based technique that enables one to compare the behavior of a system using alternative process designs in a controlled manner, whilst being empirically consistent.

Logistic regression was chosen as the main method of analysis since the outcome variable, which is clearance success and clearance delay, is binary in nature. Logistic regression can be used to estimate the likelihood of a clearance process causing delay with some combination of process structure, coordination, and technology variables. In contrast to simply descriptive measures, this approach provides the ability to compare formally various system settings with respect to explicit clearance results.

Classification accuracy, precision, recall, specificity, and F1 scores were used to evaluate and compare the performance of the traditional and improved clearance models. This analysis is not algorithmic optimization, but a comparative evaluation of the system, checking whether system-level redesign, designed as Systems Thinking suggests, will result in operationally better outcomes. It is important to note that the metrics are classification summaries of the modeled clearance results against predetermined system performance limits, as opposed to an approximation of empirical prediction accuracy of observed transactions. Reported performance values, therefore, are relative model-based measures of system performance in varying process configurations and not operational effectiveness achieved through empirical implementation.

4. Results

This study achieved three main objectives: First, it explored the current customs clearance practices and defined the major operational challenges confronted by the international logistics companies, with a specific focus on the process inefficiencies leading to delays and higher costs. Secondly, it followed process-based and technology-intensive methodology to assess how the integration of digital tools, institutional programs, and coherent regulatory mechanisms can simplify operations in customs clearance and increase efficiency and transparency. Third, it suggested an improved business process design of customs clearance and provides practical and actionable suggestions to the customs authorities and global logistics companies to trim down the clearance time, reduce the number of bottlenecks in the operations, and enhance the overall performance of the cross-border logistics operations.

From the traditional methodology of the logistics clearance process for international logistics companies, the model produces 40% efficiency and productivity in operational processes. This accuracy is calculated as the sum of the correct predictions of the business processes divided by the total number of correct predictions of all the existing processes that the model makes in a few years of operation. It is typically used in machine learning and performance metrics to identify the accuracy of the classification model. The following formula presents it:

$$Accuracy = (TP + TN)/(TP + TN + FP + FN)$$

Where:

TP (True Positive): refers to a clearance process instance where documentary evidence indicates the presence of structural efficiency conditions, such as mandatory electronic document submission via EDI, a reduced number of agency handoffs, and integrated inspection protocols, and the encoded classification model correctly identifies the instance as meeting the predefined performance threshold (e.g., timely clearance with minimal rework).

TN (True Negative): refers to a clearance process instance where documentary evidence indicates the absence of efficiency-enabling structures, such as reliance on manual paperwork, multiple sequential inspections by separate agencies, and fragmented information systems, and the encoded model correctly classifies the instance as prone to delay or inefficiency relative to the defined threshold.

FP (False Positive): occurs when documentary coding suggests the presence of efficiency-oriented features (e.g., nominal availability of an electronic submission platform), but the encoded process also exhibits delay-inducing characteristics (such as parallel manual verification or redundant approvals), leading the model to incorrectly classify the instance as efficient.

FN (False Negative): arises when documentary evidence indicates a structurally streamlined process configuration, such as integrated digital verification and limited handoffs, but the encoded model classifies the instance as inefficient due to conservative threshold settings or overlapping regulatory constraints captured in the documentation. The obtained result is presented in Figure 3.

Figure 3

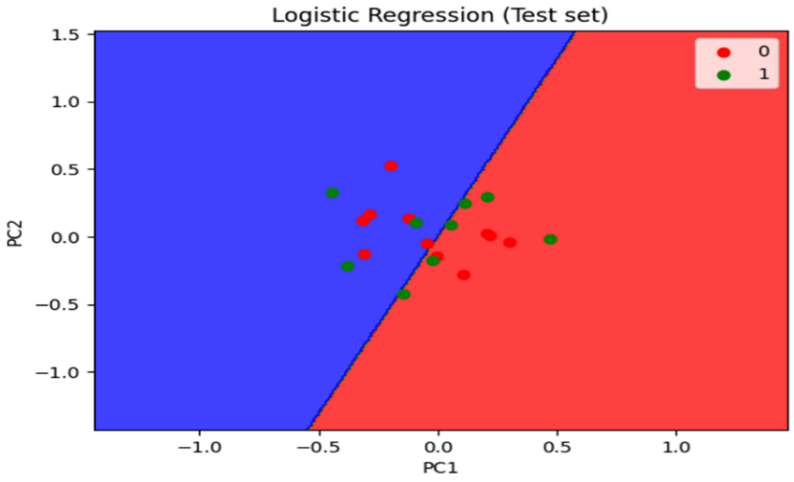
Test Set Result for Old Clearance Model

```
Confusion Matrix:
[ [5 6]
  [6 3] ]
Data1 Accuracy: 0.4
Precision: 0.4
Data1 Recall: 0.4
Data1 Specificity: 0.3333333333333333
F1 Score: 0.4
Area under Precision-Recall Curve: 0.5
```

The data analysis employed logistic regression as a statistical classification model designed to estimate the probability of a binary outcome (e.g., clearance success versus failure) based on observed predictor variables, rather than as a direct evaluator of the business process itself. Model performance was assessed using a confusion matrix and associated classification metrics derived from the model's predictions. The confusion matrix summarizes the predictive outcomes of the logistic regression model in terms of true positives (TP), false positives (FP), true negatives (TN), and false negatives (FN). Based on these outcomes, the overall classification accuracy of the model was 0.40, indicating that the model correctly classified 40% of the observations associated with the traditional (old) clearance process. This relatively low accuracy suggests limited predictive alignment between the observed predictors and the clearance outcomes under the existing process structure. In addition, the precision on the other hand, is a measure, which is the percentage of correctly predicted positive instances (TP) of all the instances that are predicted as positive (TP + FP). It is used in order to test the ability of the model to prevent false positive. In order to consolidate the data that is tested by all the algorithms, the Principal Component Analysis (PCA) was employed, and the best-performing algorithm is the logistic regression as modeled in Figure 4.

Figure 4

Test Set for Logistics Regression (Source: Derived Old Clearance Process)



From Figure 4, the logistics regression model plotted above, the red and blue areas represent the decision regions of the logistic regression model in the reduced feature space defined by PC1 and PC2. Statistically, the boundary between these regions corresponds to the point where the predicted

probability of belonging to either class equals 0.5. Observations in the red region are classified as class 0, while those in the blue region are classified as class 1, based on estimated probabilities rather than actual clearance outcomes. The visible overlap of observations across both regions indicates limited class separability and a high likelihood of misclassification. This pattern is consistent with the low accuracy and specificity reported and suggests that the selected predictors, even after PCA, provide weak discriminatory power. Importantly, the figure reflects model behavior on the test dataset only and should be interpreted as a statistical evaluation of out-of-sample predictive performance, not as evidence of real-world customs clearance effectiveness.

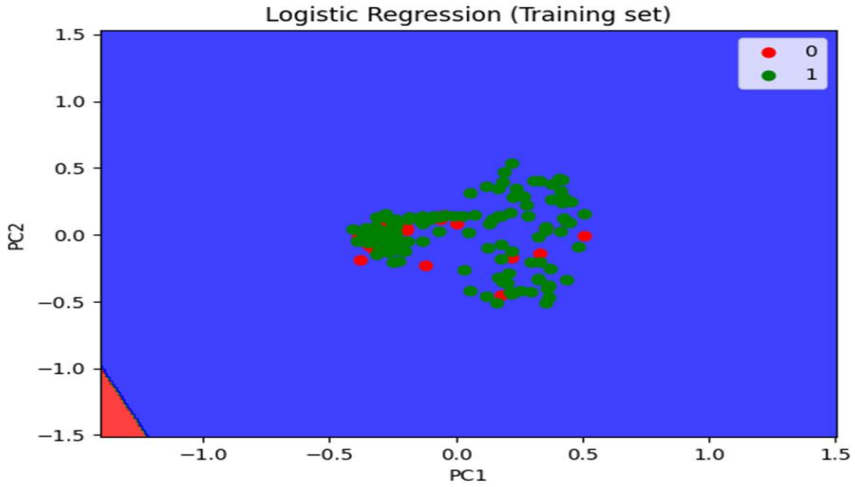
The result for the proposed clearance model is presented in Figure 5.

Figure 5
Training Set Result for Improved Model

```
Confusion Matrix:
[ [0 6]
[0 44]]
Data1 Accuracy: 0.88
Precision: 0.7744
Data1 Recall: 0.88
Data1 Specificity: 1.0
F1 Score: 0.8238297872340425
```

The accuracy ratio of correctly predicted positive (TP) of the overall number of predictions as positive (TP + FP) is 77.44%, which is the ability of the model not to give a false positive. In the same manner, the F1 score of 82.4% depicts the overall positive behavior of the model on the operational clearance processes. The accuracy of the data is 0.88, representing 88%, accounting for improved clearance process as compared with the 40% data accuracy for the old process, which is herein referred to as the traditional customs clearing process. It is important to understand that the result is derived from models rather than empirical implementation (See Figure 6).

Figure 6
Logistic Regression (Training Set) for Improved Clearing Process



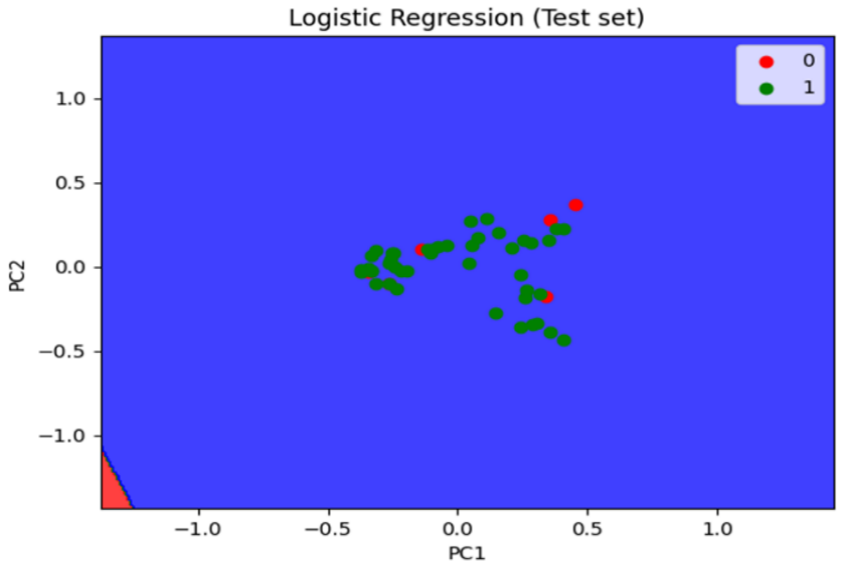
In logistic regression, the training set is a set of labeled examples on which learning is performed to understand the relationship between the input features and the corresponding labels of the classes. These class labels were explained in the data as the number of hours spent by companies or their agents on

clearance at the port authorities' departments, customs, and other security operatives. It also encompasses clearance expenses, gate collections, processing fees, excise and customs duties, and value-added tax. Analysis of the improved process model captured a dataset of past customs clearance cases. Each case is described by the item description, value, origin, destination, delays in hours, and processing fees. The labels of the classes indicate whether the clearance was successful or not, with 0 and 1 representing failure and success, respectively.

From the results obtained by capturing the variables of the improved clearance process, a confusion matrix and an accuracy level of 88% was achieved, as compared with the 40% accuracy level for the old clearing process (See Figure 7).

Figure 7

Logistic Regression (Test Set) for Improved Clearing Process



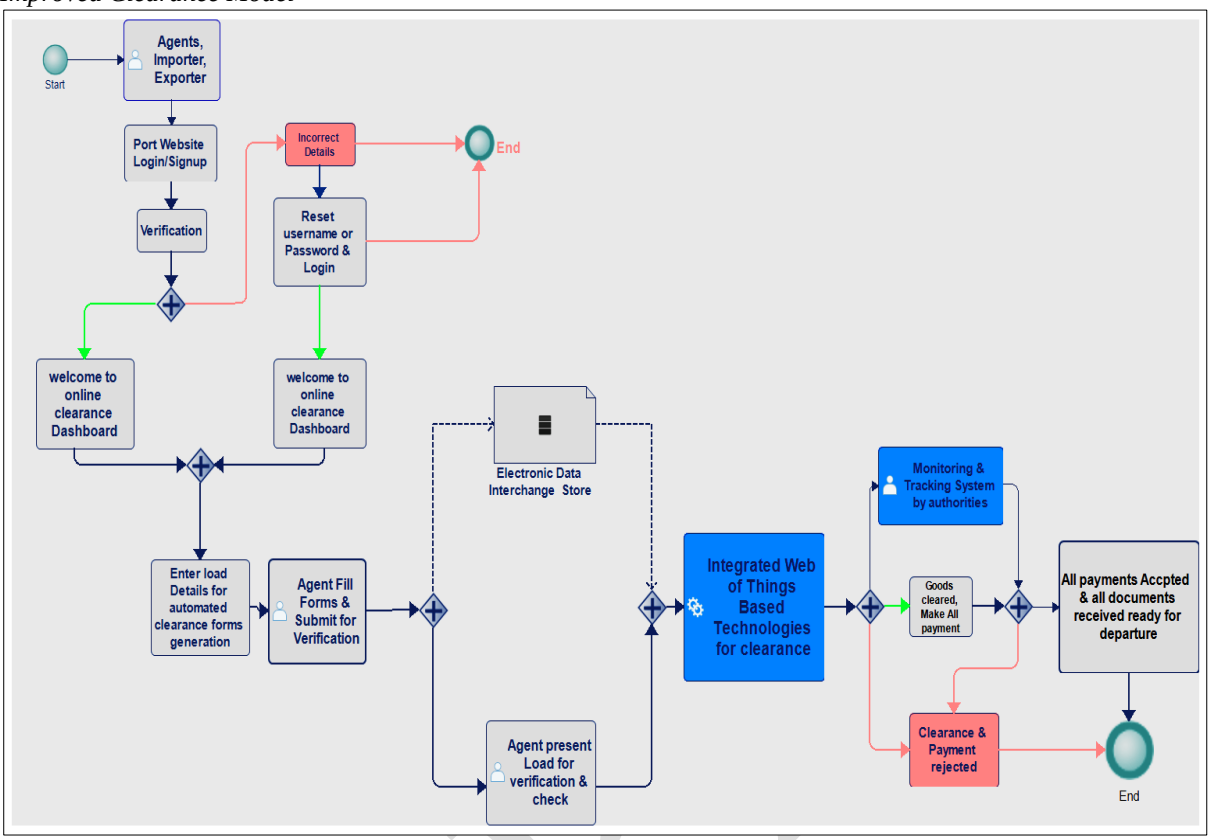
The data was used to evaluate the performance of the confusion matrix of the logistic regression for the proposed clearance process. Specifically, the performance and accuracy level of the proposed online clearance facilitated by Web of Things (WoT) technologies utilizing the data stored in the electronic data interchange produced 88% best performance. The process will streamline the number of hours spent to a minimal level by bringing the agents, port, security, and customs authorities, or their representatives, to work together in a single department to avoid dubious bureaucracies, thereby drastically reducing the waiting time and costs involved.

Figure 8 presents the proposed clearance process model at the port, structured into two interconnected folds: the online clearance initiation by stakeholders (such as importers, exporters, shippers, and agents) and the physical completion at the port facility. The model also separates two kinds of flows: dotted lines, representing the flow of digital information, and solid lines, representing the physical flow of materials or goods. It will start with the stakeholder registering or logging on to the web-based clearance system of the port. In case of verification failure (e.g., wrong login credentials), the process is stopped (as illustrated by the red line).

If successful (as shown by the green line), the user is granted access to the clearance dashboard, where shipment details such as load description, weight, type of commodity, departure/arrival ports, and estimated costs are entered. Based on the received information, it will create an automatic clearance form that provides the ability to add more details and attach some supporting documents to check the shipment. These are usually the Certificate of Origin (COO) prepared by the Chamber of Commerce, Bill of Entry (BOE), import/export licenses, and commercial invoices.

Figure 8

Improved Clearance Model



The documentation and data are kept in the Electronic Data Interchange Store (EDIS) as soon as they are submitted and can be accessed and reviewed on a system-wide basis. Simultaneously, a physical verification gateway is activated where the goods are presented for checks. At this stage, the Integrated WoT-Based Technology System is engaged. WoT, which is a continuation of the Internet of Things (IoT), allows the free flow of interactions between connected devices and web services. The automation of detection, scanning, and verification in this clearance process is done by WoT employing the X-ray machine, narcotic traces detectors, millimeter-wave scanners, RFID tags, and metal probes.

In the course of these, all the security checks against contraband, counterfeit goods, or concealed narcotics are possible. Depending on the result of the screening, the system gives the final payment clearance or refuses it, and the process is terminated. Goods accepted are then tracked and monitored with RFID microchips, and one can track the load on trucks, trailers, ships, or other cargo vessels in transit to their destinations in real time.

However, the proposed model of customs clearance has a number of potential constraints in terms of implementation. First, the use of EDI, WoT, RFID, and automated scanning technologies brings with it great financial and technical demands that cannot be handled by all ports and customs administrations. Second, the presence of interoperability difficulties that are caused by the heterogeneity of the existing legacy systems and non-standard data standards can limit the smooth integration of systems. Third, regulations and laws on the sharing of data, security, and automated decision-making might limit full implementation of the model. Fourth, institutional and political obstructions amid bureaucratic traditions and settings might damage interagency cooperation and transparency of processes. Lastly, the human capacity and change-management constraints can limit successful adoption, especially where there is a low level of technical expertise.

These constraints can be mitigated through phased and modular implementation strategies, supported by targeted capacity building and incremental interoperability standards. In parallel, regulatory

alignment, stakeholder engagement, and pilot testing can be used to manage institutional resistance and adapt the model to local operational and legal contexts.

5. Discussion

In line with the study objectives, this paper explored the current customs clearance practices and the major operational challenges confronted by the international logistics companies. It also adopted a process-based and technology-intensive methodology to assess how the integration of digital tools, institutional programs, and coherent regulatory mechanisms can simplify operations in customs clearance and increase efficiency and transparency. An improved business process design of customs clearance that guide practical and actionable suggestions to the customs authorities and global logistics companies to streamline the clearance time, reduce the number of bottlenecks in the operations, and enhance the overall performance of the cross-border logistics operations is provided.

The design choices made in the study pertaining to the model design took the feasibility constraints and comparative relevance as opposed to technological optimization. The choice of WoT elements represents already established technologies in customs and port operations and was considered an enabling architecture to integrate systems, and not a cost-effective or prescriptive solution. Dotted and solid lines are structural abstractions used to differentiate information and material flows, which is in line with the Systems Thinking modeling practice. Although the study does not involve formal cost-benefit, sensitivity, and simulation-based verification, it uses comparative scenario analysis to evaluate the effect of alternative process structures on the performance of the system at the level of the system. Under this, it can be seen that the model is to be operated as an analytic-based framework of design and not a complete parameterized blueprint of operational deployment.

This paper has analyzed the inefficiency of the traditional practices of customs clearance as far as the international logistics companies are concerned, and what can be done to improve the situation based on the BPR and Systems Thinking models. The conventional system, which had a bureaucratic slowdown, paperwork, and poor agency interaction, proved to have very low operational efficiency of only 40, as illustrated by the confusion matrix and logistic regression model. This ineffectiveness is revealed through long clearance time, high clearance rates, high risk of cargo damages, and vulnerability to illegal trade practices- all these affect the competitiveness and reliability of the international logistic systems.

The presented clearance process, including a built-in WoT system and EDI, can be characterized by a significant improvement in the performance of various parameters of operation. With a newly achieved score of 88% accuracy, the new model will allow real-time validation, centralized data access, and automated scanning, making all of this less physical contact, less redundancy, and more regulatory compliance-friendly. As shown in Appendix, integrated WoT-based technologies, containing technologies as Millimeter wave scanner, meter detection and probe, X-ray machines and RFID tracking, and narcotic trace detection systems enhance the security and transparency, which not only resolve the issue of economic inefficiency, but also the issue of national security.

In summary, the study applies a systems-based analytical framework to examine how alternative customs clearance process designs may influence operational performance. The findings do not represent empirically observed efficiency gains but provide a comparative, model-based assessment of traditional and redesigned clearance architectures under controlled assumptions. The use of statistical classification metrics serves an exploratory purpose, enabling structured comparison of modeled system behavior rather than empirical validation of real-world outcomes. The results suggest that integrated process designs incorporating earlier feedback mechanisms and reduced fragmentation may exhibit more favorable performance tendencies, consistent with Systems Thinking principles. The contribution of this study lies in offering a formal, design-oriented framework for evaluating customs clearance processes, extending prior descriptive research. The proposed model should therefore be interpreted as a normative blueprint that informs future empirical testing, pilot implementation, and institutional feasibility analysis, rather than as evidence of proven operational effectiveness.

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Appendix

Components of Integrated WoT-Based Technologies