International Journal of Engineering and Management Sciences (IJEMS) Vol. 7. (2022). No. 1
DOI: 10.21791/IJEMS.2022.1.9.

Long Container Dwell Time at Seaport Terminals: An Investigation Study from a Consignee Perspective

A. EWAMER[1], J. MENYHÁRT[2]

[1]University of Debrecen, Faculty of Engineering, Department of Engineering Management and Enterprise
[2]University of Debrecen, Faculty of Engineering, Department of Road -and Air Vehicles

Abstract. Many companies are concerned about the problem of increasing average dwell time for their import containers at the port of the final destination and therefore incurring additional shipping costs in form of demurrage charges for the port administration and detention charges for the shipping line. Previous studies have addressed this topic by analyzing terminal operations and evaluated its effects on port productivity and competitiveness; however few studies have explicitly explored long container dwell time causes from a consignee perspective. This research aims to identify the causes of long dwell time for the import containers at port storage yards for one of the leading FMCG companies in Jordan. To that end, the data of import containers whose stay at the terminal exceeded the free storage days in the period between 2019 and 2020 were collected by referring to the set of shipping documents and reviewing the correspondences between the consignee and other parties in the supply chain. Based on the timelines that have been analyzed for each case of delay to the collection of shipping documents in consideration with the payment terms, as well as the clearance and delivery timelines, ten causes for the long container dwell time have been identified and classified into three main categories according to the types of flow in the supply chain; five causes related to information flow, two causes related to cash flow, and three causes related to physical flow. The impact of these causes has been evaluated using the demurrage and detention charges as a measure indicator and the findings of this research have also revealed that the causes related to cash flow have a greater impact than the other types of causes.

Keywords: Container Shipping Industry, Import Shipping, Container Dwell Time, Demurrage and Detention Charges

Introduction

Container Dwell Time (CDT) is the period of time the container spends in the terminal storage yard after being unloaded from the ship in the case of import or before being loaded to the ship in the case of export. The efficiency of the terminals is measured by two main factors: the average CDT and the turnover of the containers. The less average CDT, the better for terminals, since it is considered an indicator of terminal operations' speed and performance and allows the terminal to receive and handle more containers. Many research studies have been conducted with the aim of reducing the CDT. A major part of these studies provides solutions that focus on improving container flow and storage capacity. These solutions such as optimizing yard space allocation, creating additional container depots outside the terminals, and improve

DOI: 10.21791/IJEMS.2022.1.9.

the staking and handling technologies are considered expensive solutions and complicated to implement.[1]

Import containers remain stacked at the port storage yard, waiting for certain activities to take places, such as the clearance process and the customs inspections. Terminal management gives the consignee free storage days to complete all the required procedures. The consignees and their brokers shall endeavor to finalize all clearing procedures and transport their containers outside the terminal within this free time period to avoid the payment of additional costs, such as demurrage charges to the terminal or detention charges for the shipping lines. The aim of this research is to identify the causes of the long dwell time for the import containers at port storage yards from the consignee perspective.

The data for this study is provided by one of the largest FMCG firms in Jordan. The company's import containers arrive by Aqaba port, the only maritime outlet in the country located on the Red Sea, south of Jordan. The port of Aqaba was founded in 1952.[2] In 2003, the container terminal was confronted with major operational issues that led to a crisis of congestion. Aqaba Development Company (ADC) was launched in 2004 to address this challenge and attract investments from the private sector. In 2006, ADC signed a 25-year joint venture with APM Terminals, resulting in the creation of the Aqaba Container Terminal (ACT).[3] Warehousing and logistics services are offered by Aqaba Logistics Village (ALV) to support ACT. ALV is one of the ADC Business Units and is managed by APM Terminals as well.[4]

1. Literature Review

Transportation is an essential aspect of logistics, and developments in transportation infrastructure have played a key role in countries' integration into the global economy. Investments in the transportation infrastructure reduced cost, increased efficiency, and facilitated trade. As a result, transportation costs and efficiency have become increasingly important for all countries. Furthermore, transportation investments and innovations in the telecommunications sector contribute to economic growth.[5] Logistics is important because it creates value for the customers that expect a quick response to their demand. Products and services have little or no value unless they are in the possession of customers. As a result, successful logistics strategy has become increasingly critical within most firms for maintaining a competitive advantage and penetrating new markets.[6]

Supply chain flows are classified in a variety of ways. Supply chains include three key flows: physical flow of materials, information flow, and resources flow which help supply chains to operate effectively.[7] Another classification includes four key flows: goods flow, services flow, information flow, and cash flow.[8] Physical flow moves inventory from one point in the supply chain to another using a variety of modes and routes.[9] Transport, warehousing, customs checks, handling, and other forms of activity are all examples of physical flow.[10] The heart of successful supply chains is the information flow. Companies with higher levels of information exchange have performed better as the sharing of information across the supply chain enables firms to be more responsive.[11] The information also includes the documents that need to be transferred for cargo shipping. Cash flow refers to the flow of cash mainly from customers sectors to business sectors that provide goods and services, and in the opposite direction from business sectors to

DOI: 10.21791/IJEMS.2022.1.9.

customers sectors in form of credit notes and discounts in some cases. All types of flow are integrated and depend on each other.

The Import shipping process starts when the buyer orders goods from the supplier. The buyer issues a Request for Quotation (RFQ) to the supplier, who responds with an estimated offer in the form of a Proforma Invoice (PI). After the buyer and the supplier have agreed on the quote and payment terms, the buyer creates a Purchase Order (PO) that should be governed by one of the Incoterms. The PO is an official contract that specifies the details of the order as well as the expected delivery dates. After receiving the PO, the consignor prepares and packs the goods and asks the freight forwarder to arrange for the shipping process. The number of empty containers required, and the date of loading should be informed to the freight forwarder. The arrangement of the goods is recorded in a document known as the Packing List (PL), which is critical to the consignee's warehouse officers during the receipt processes. The goods are loaded onto the truck, and the containers are transported to the port. The containers are checked by the customs and moved to the container yard after finalizing the clearance process and arranging the Customs Declaration (CD) by the broker.

The container ship sails from the port of origin to the port of destination passing by many transit ports by its route in most cases. When a ship arrives at the port, it has to moor at one of the available berths at the quay. Quay cranes take the containers off the deck and vehicles move them to the container yard or the stack area which consists of several lanes where containers can be temporarily stored and transported by straddle carriers. Containers are then transferred through the inter-terminal transport to various modes of transportation. A large number of containers must be handled in a short period of time.[12] Figure (1) illustrates the physical flow in container shipping industry.

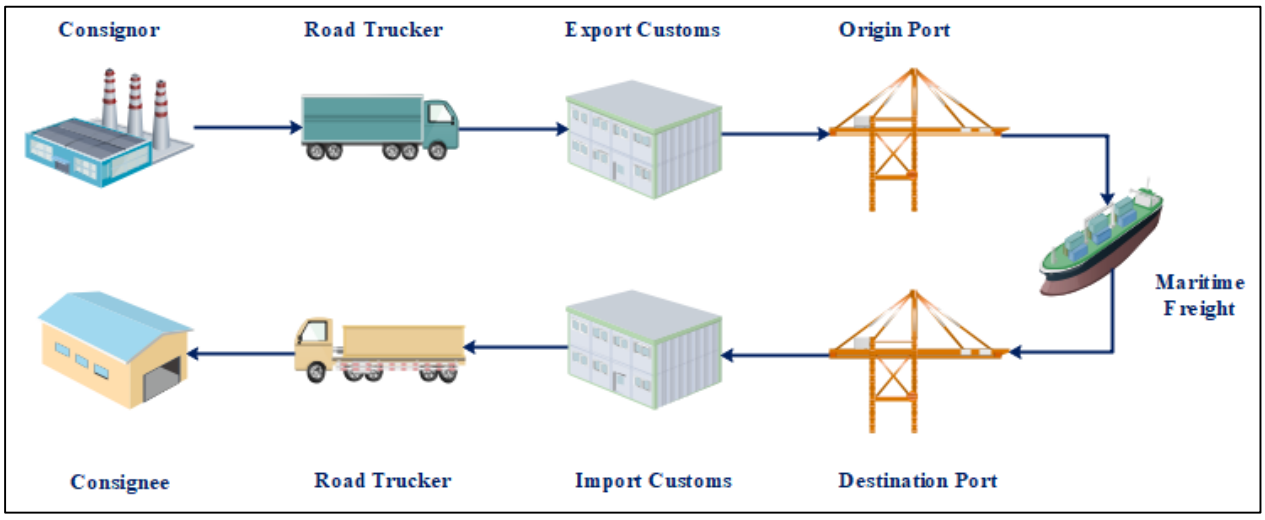

Figure 1: Physical Flow in Container Shipping Industry (Source: The Author)

The container yard plays a vital role in the terminal operations as it situated between two demands, one associated with the flow of containers between the yard and the seaside and the other associated with the transfer of containers between the yard and the landside. From an operational point of view, the container yard functions as a storage area and it is physically a buffer area for containers transferred in the handling

DOI: 10.21791/IJEMS.2022.1.9.

operations related to the vessels and others related to the road trucks. On the other hand, and from the managerial point of view, the container yard is the area where the planning and control are concentrated as the terminal complex patterns of demand need high quality management standards. Definitely, the efficiency of the storage yard operations influences all the terminal operations. While the import containers are being discharged and stacked in the yard, notifications are being sent to the consignees who have to prepare with their brokers the required documentation such as the import licenses and government approvals in addition to the shipping documents provided by the consignor to complete the clearance process and the customs inspections. The relationship between the documents flow, and the cash flow is represented by the concept that the flow of the original shipping documents is primarily dependent on the payment terms. The information flow and cash flow are shown in Figure (2).

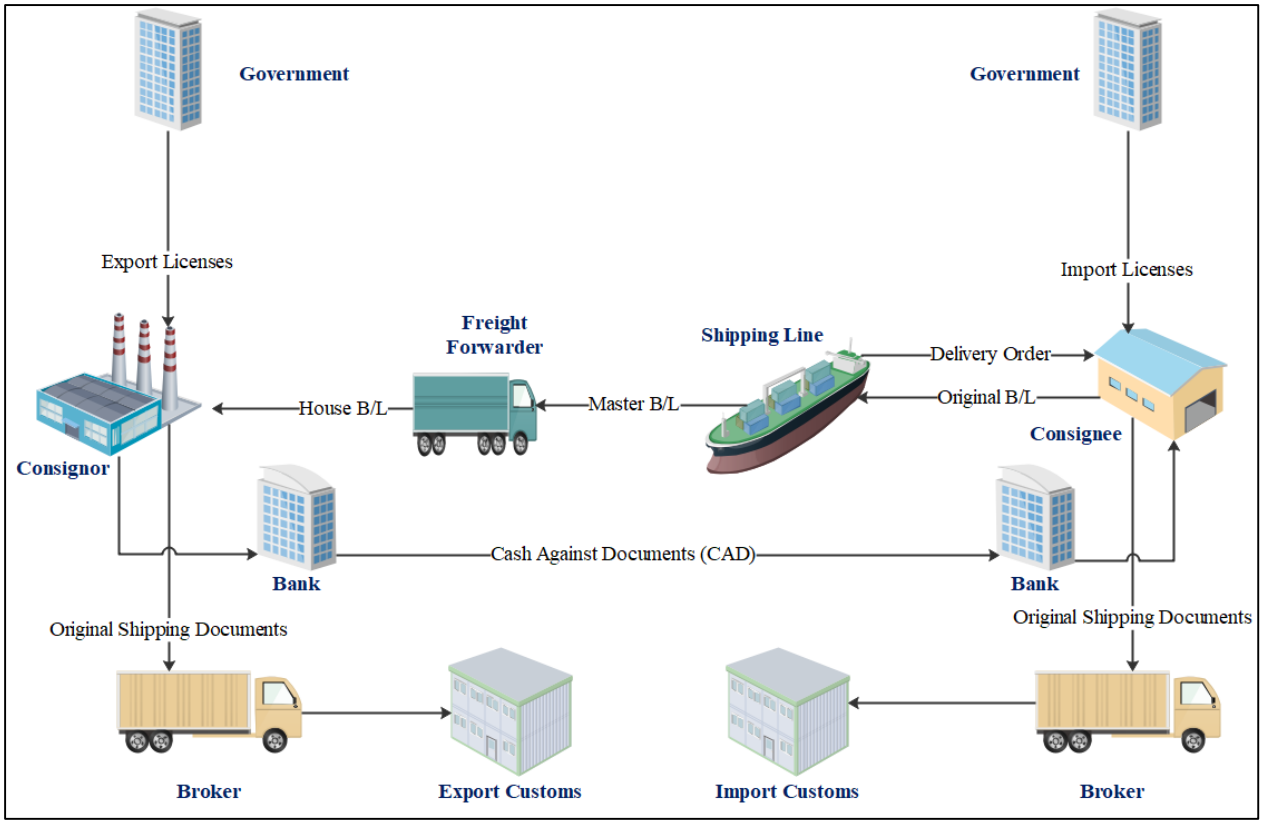

Figure 2: Information Flow and Cash Flow in Container Shipping Industry (Source: The Author)

Many researchers have attempted to estimate the impact of the average CDT on the container yard capacity. Dally (1983) developed a formula using the average container dwell time and other factors to estimate the annual yard capacity or the number of containers that the storage yard can accommodate.[13] Hoffman (1985) used the average container dwell time, the expected container volume, and the area per container, to estimate the container yard area.[14] Merckx (2005) performed a sensitivity analysis to evaluate the impact of dwell time on terminal capacity, considering five scenarios with different dwell periods and container types.[15]

DOI: 10.21791/IJEMS.2022.1.9.

According to Rodrigue and Notteboom (2009), inland terminals are increasingly being used as extended gates to seaport terminals, reducing containers dwell times at seaport ports by transferring them inland.[16] Huynh (2008) introduced simple methods to evaluate the effect of CDT and storage policies on import throughput and rehandling productivity considering two import storage strategies, for the non-mixed storage policy, without stacking of new import containers on top of old ones, the increasing container dwell time lowers throughput and increases in rehandling productivity. In contrast, for the mixed storage policy, with the stacking of new import containers on top of old ones, the increasing container dwell time raises throughput and decreases rehandling productivity.[17] Huang (2008) demonstrated that the higher CDT, the more non-value-added movements that lead to a decrease in the efficiency of the terminal operations and increase the cost.[18] Kourounioti (2016) proposed the development of a methodological framework that incorporates the various factors affecting the CDT in container terminals. The proposed methodology required the collection of aggregate data and the use of Artificial Neural Networks to discover these CDT determinant factors (ANN). The findings revealed that the container size and type, the day and month of the container's discharge, the vessel's port of origin, and the commodities transported are the most critical factors determining the model's accuracy.[19]

Inland transport refers to all activities that occur between the release date when the container becomes available for pickup inside the seaport and the arrival date at the final destination. Demurrage and detention charges only have an impact on this part of a container's overall journey. The demurrage period begins on the date of release and ends when the container departs the port. The container's detention period begins when it leaves the seaport and ends when it is returned empty to the shipping line at an agreed-upon seaport terminal. Each container is given a free demurrage period and a free detention period, and this is called separated D&D. While when a single free period is granted for both demurrage and detention this is called combined D&D. The combined D&D appears more flexible option that can provide similar income for shipping lines with lower average dwell times.[20]

2. Data Collection and Analysis

All the necessary data was collected to comprehend the shipping circumstances and identify the causes of the delay for the company's import containers by referring to the set of shipping documents for each PO and reviewing the correspondences between the consignee and the other parties in the supply chain. Data was gathered in relation to each PO, as several import containers may be associated with the same PO. In other words, different containers may be affected by the same circumstances, and therefore, have the same cause of delay. The collected data can be classified into three categories as following:

2.1 Reference Information and Cargo Details

The first category of data collected includes reference information about the order as well as general cargo details. These data are taken into consideration by the terminal administration in the demurrage charges calculations and by the shipping lines in detention charges calculations. This study considered two types of container shipments: Full Container Load (FCL) shipments, in which the consignee owns the entire contents of the container, and Less Than Container Load (LCL) shipments, in which the consignee owns only a portion

DOI: 10.21791/IJEMS.2022.1.9.

of the contents of the container. The data analysis for FCL shipments is standardized with the Twenty-Foot Equivalent Unit (TEU). The full containers come in two sizes: a 20-foot container, which equals one TEU, and a 40-foot container, which equals two TEUs. While the data for LCL shipments are calculated by using the Cubic Meter (CBM) unit. This study investigated the cause of delay for 90 full containers, the size of 63 of these containers were 20-foot and 30 of them were 40-foot which equal 123 TEUs. These containers also can be classified into 88 dry containers and 2 reefer containers. While 29 CBM were in the LCL shipments. Figure (3) depicts the needed cargo details, which are usually found in the bill of lading document.

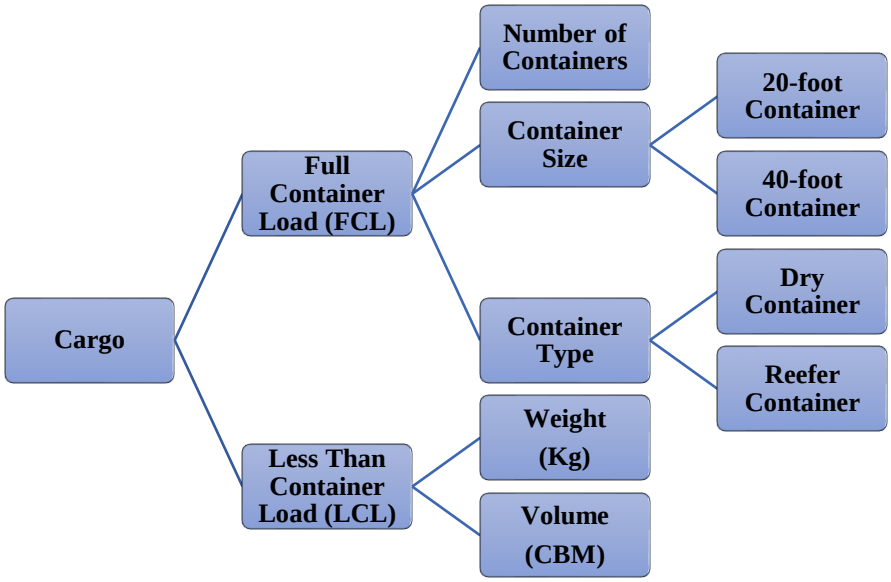

Figure 3: Cargo details (Source: The Author)

2.2 Documents Collection Timeline

The integration of physical, cash, and information flows is the heart of a successful supply chain. The flow of the original set of shipping documents which is an example of an information flow is associated with the physical and the cash flows. The delivery of the original set of shipping documents to the consignee's broker prior to the Actual Time of Arrival (ATA) is a critical factor in utilizing the free storage period at the Port of Discharge (POD) from the first day, since any delay in sending the original documents to the broker might cause a delay in the clearance process, and possibly an extension of the container's dwell time at the terminal containers yard, which will lead to extra storage fees. The flow of documents from the consignor to the consignee starts after the Actual Time of Departure (ATD) and should be completed before the ATA, this period is called the Actual Transit Time. The delivery of shipping documents to the consignee within the actual transit time is an example of the relationship between the documents flow and the physical flow. The concept that the flow of the original shipping documents is primarily dependent on the payment terms represents the relationship between the information flow and the cash flow. Figure (4) depicts the

DOI: 10.21791/IJEMS.2022.1.9.

necessary data that was gathered to understand the document flow and identify any issues with delivering the required documents on time in the case of a Cash Against Documents (CAD) payment term.

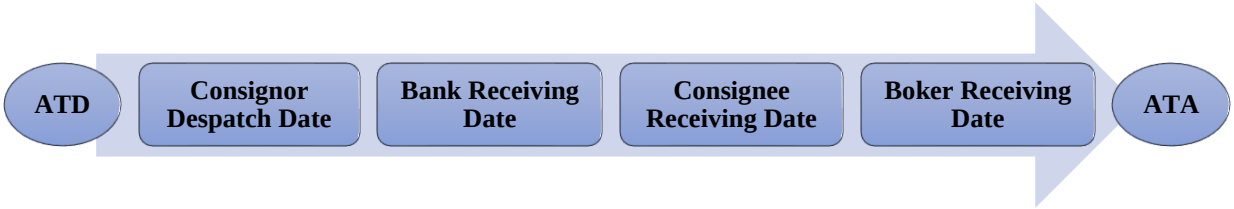

Figure 4: Documents Collection Timeline with Bank Intervention (Source: The Author)

In case of Open Account payment term or Payment in Advance, the flow of documents from the consignor to the consignee will be directly without the intervention of the bank as shown in Figure (5).

Figure 5: Documents Collection Timeline without Bank Intervention (Source: The Author)

2.3 Clearance and Delivery Timeline

Following the ATA, the freight forwarder notifies the consignee of the readiness of the Delivery Order (DO) document, the consignee asks the broker to collect the DO and arrange the import Customs Declaration (CD). Once the broker finalizes the clearance procedures, the land transporter transports the containers outside the port to the consignee's warehouse, and after the offloading, the land transporter returns the empty containers back to the shipping line in case of FCL shipments.

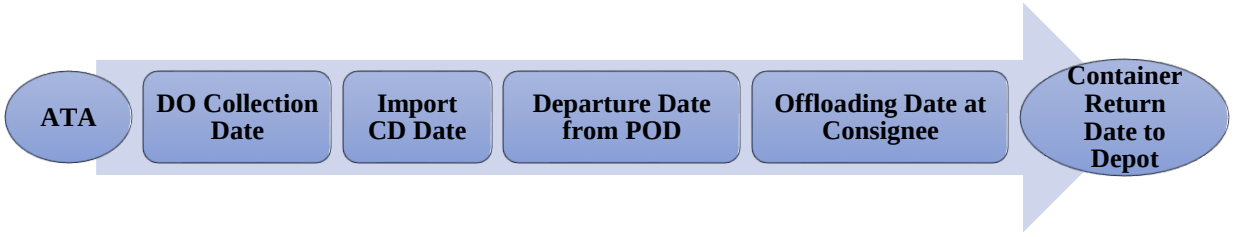

Figure 6: Clearance and Delivery Timeline (Source: The Author)

The demurrage period starts after the ATA when the container is ready for pick up inside the terminal and ends when the container leaves the port. While the detention period for a container begins on the date of departure and ends when the container is returned empty to the shipping line after the offloading. Before the charged period, each container is given a free demurrage period and a free detention period. The following tables show the tariff for the storage period and the number of free days for the import containers handled by ACT, noting that a little increase happened in the fees in September 2019.

DOI: 10.21791/IJEMS.2022.1.9.

Table 1: Demurrage Charges for the Import Containers by ACT (Source:[21]*)*

Period	Demurrage Charges Per Container Per Day (JOD)			
	20-foot Container		40-foot Container	
	Before September 2019	After September 2019	Before September 2019	After September 2019
Free days Period (6 days)	Free	Free	Free	Free
First Period (7 days)	5.20	5.40	10.30	10.80
Second Period (7 days)	20.70	21.60	41.30	43.20
Thereafter	41.30	43.20	82.60	86.30

Additional fees are due on the reefer containers that have to be stored in a suitable environment and electrical supply for cooling. These fees are shown on Table 2.

Table 2: Reefer Electricity Plug Charges (Source:[21]*)*

Container Size	RE Charges Per Container Per Day in (JOD)	
	Before September 2019	After September 2019
20-foot Container	25.30	26.40
40-foot Container	40.50	42.30

The following equation shows the calculation of the demurrage charges for the import containers handled by the ACT.

$$Pt = DT - FP \quad (1)$$

$$Pt = P1 + P2 + P3 \quad (2)$$

$$Demurrage\ Charges = P1 \times D1 + P2 \times D2 + P3 \times D3 + Pt \times RE \quad (3)$$

Whereas:

DT: Container Dwell Time

FP: The Free Storage Period (Constant: PF = 6 days)

Pt: Total Number of Storage Days after the Free Storage Period

P1: Number of Storage Days within the First Period

P2: Number of Storage Days within the Second Period

P3: Number of Storage Days within the Third Period

D1: Demurrage Charges Per Container Per Day in JOD for the First Period

D2: Demurrage Charges Per Container Per Day in JOD for the Second Period

D3: Demurrage Charges Per Container Per Day in JOD for the Third Period

DOI: 10.21791/IJEMS.2022.1.9.

RE: Reefer Electricity Plug Charges Per Container Per Day in JOD

The following table shows the tariff for the storage period and the number of free days for LCL shipments handled by ALV.

Table 3: Storage Fees for the LCL Shipments by ALV (Source:[22]*)*

Period	Storage Fees per CBM/Ton whichever is higher in (JOD)
Free days Period (6 days)	Free
First Period (6 days)	0.50
Second Period (6 days)	1.00
Third Period (6 days)	1.75
Fourth Period (Thereafter)	2.20

The following equation shows the calculation of the demurrage charges for the LCL shipments handled by the ALV.

$$Pt = DT - FP \tag{1}$$

$$Pt = P1 + P2 + P3 + P4 \tag{4}$$

$$Demurrage\ Charges = P1 \times D1 + P2 \times D2 + P3 \times D3 + P4 \times D4 \tag{5}$$

Whereas:

P1: Number of Storage Days within the First Period

P2: Number of Storage Days within the Second Period

P3: Number of Storage Days within the Third Period

P4: Number of Storage Days within the Fourth Period

D1: Demurrage Charges Per CBM/Ton whichever is higher in JOD for the First Period

D2: Demurrage Charges Per CBM/Ton whichever is higher in JOD for the Second Period

D3 Demurrage Charges Per CBM/Ton whichever is higher in JOD for the Third Period

D4: Demurrage Charges Per CBM/Ton whichever is higher in JOD for the Fourth Period

3. Results and Discussion

The causes of long container dwell time for the company's import containers that were delayed on the port terminals for more than the free storage days in the period of 2019 and 2020 have been investigated and determined by collecting the data about each case and draw the documents collection timeline as well as the clearance and delivery timeline. Ten causes of long dwell time have been discovered based on a comprehensive review of 70 cases: 60 FCL shipment cases and 10 LCL shipment cases.

DOI: 10.21791/IJEMS.2022.1.9.

- Delay in sending the set of the shipping documents by the consignor

Shipping documents such as the bill of lading, commercial invoice, certificate of origin, and other health and safety certificates are essential in receiving and clearing cargos in the port of destination. These documents are prepared by the consignor to be sent to the consignee before the arrival of the cargo. Delays in preparing these documents, as well as any missing or inaccurate information, have an influence on the CDT. The consignor starts preparing the set of shipping documents after the ATD. Sometimes the consignor encounters problems in this process, forcing him to be late in delivering the documents on time, this may lead the arrived containers to be delayed at the port of discharge waiting for the shipping documents particularly when the actual transit time for the freight is short.

- Missing information in the set of shipping documents sent by the consignor

The Harmonized System (HS) Codes for the traded products, as well as the cargo's country of origin, are used by customs authorities to determine duties and taxes on the customs declarations. The commercial invoice usually includes the product description and the HS code, while the Certificate of Origin (COO) is issued to indicate the goods' preferential origin. In case of trading with countries that have preferential tariff agreements with the EU countries, stating the Customs Authorization Number (CAN) on the commercial invoice indicates the country of origin for the goods and compensates the COO document. In some cases, these important details were missing from the documents and that led to extending the container dwell time at the terminal as the consignor had to correct these documents and send them again.

- Delay in the issuance of import licenses and approvals by the government authorities

In the FMCG sector, government authorities such as health and agriculture ministries, chambers of commerce and industry, Food and Drugs Administration (FDA) agencies have the main role in facilitating import and export procedures as the export/import licenses and approvals are issued by them. The consignee should prepare theses required documentation in addition to the shipping documents provided by the consignor to obtain the cargo and complete the clearance process. Long and complicated transactions at government authorities may hinder the clearance and customs procedures.

- Inaccurate Information in the import licenses and approvals by the government authorities

Import licenses and approvals provide information about the traded products, such as the description of the goods, the manufacturer, the country of origin, quantity limits and time limits for processing clearance applications for the approved quantities. If there is incorrect information in the import licenses and approvals, the clearance process and customs procedures can also be delayed.

- Delays in the issuance of Delivery Order by the Freight Forwarder

The delivery order is a document issued by the freight forwarder to release the cargo to the consignee's broker at the port of final destination. During the data analysis, one of the causes for a long container dwell time was a delay in the issuance of the DO by the freight forwarder to the consignee's broker.

- Payment delay to the bank by the consignee

A business has liquidity issues when it does not have the cash required to fulfil its due payments on time. Companies face liquidity problems as a consequence of the customers' late payments, which has a direct impact on their financial performance. Payment delay to the bank by the consignee in case of cash against documents payment term will delay the receipt of the shipping documents required to receive the cargo causing the container to spend more time at the terminal yard and incurring additional demurrage and detention costs for the consignee.

- Payment Delay to the broker by the consignee

In addition to the delayed payments to the bank in order to collect the shipping documents in CAD payment term cases, the causes of the long container dwell time, which is related to cash flow, may result in delayed payments to the broker as well. In this case study the company and the broker have an agreement in which the broker pays customs duties and taxes on the behalf of the company up to a certain amount. If the company exceeds this credit limit the broker will cease paying additional fees on its behalf, causing the company's import containers to be held at the port until the company settles its debts with the broker.

- Transportation delay due to public holidays in Jordan

The first cause related to the physical flow of containers being delayed is public holidays in Jordan. Six cases were delayed due to three or four-day holidays for the company's warehouses and the land transporter, resulting in 514.40 JOD costs on the company.

- Transportation delay due to congestion at port

In the container shipping industry, ports are considered critical nodes in the physical flow of cargos. Congestion at container terminals causes over stacking of containers, resulting in delays in handling and transporting them and therefore extending the containers dwell time at the container yards inside the ports. Congestion at Aqaba port was the main cause of delay for many of the company’s import containers.

- Transportation delay due to COVID-19 lockdown

On December 31, 2019, World Health Organization (WHO) received notification of cases of pneumonia of unknown cause in Wuhan City, China. Chinese authorities identified a novel coronavirus as the cause on January 7, 2020, and it was temporarily named “2019-nCoV.”.[23] In November 2019, the number of infected cases with the virus in Jordan was high and the government announced the period between 11 and 15 November as a full curfew and this affected the transport of two containers that were waiting to be cleared and transported from the terminal yard.

Ten causes for the long dwell time have been identified. These causes were classified into three categories: causes related to information flow, causes related to cash flow, and causes related to physical flow. In 15 cases, the cause of the delay was related to information flow, in 33 cases, it was related to cash flow, and in 22 cases, it was related to physical flow. In FCL shipments, the cash flow causes constituted a significant portion of the overall cost. The company paid 277.1 JOD as demurrage and detention charges due to causes related to information flow, 11,671.77 JOD due to causes related to cash flow, and 1,727.42 due to cases

related to physical flow. While the causes related to information flow constituted the major portion of the total expenses in the LCL shipments. The company paid 218.5 JOD as demurrage and detention charges due to causes related to information flow, 21 JOD due to causes related to cash flow, and 21 JOD due to cases related to physical flow.

Table 4: Causes of long container dwell time (Source: The Author)

Type of Flow	Cause	Number of Cases	Demurrage and Detention Charges (JOD)
Information Flow	Delay in sending the set of the shipping documents by the consignor	2	150.70
	Missing or inaccurate information in the set of shipping documents sent by the consignor	3	124.30
	Delay in the issuance of import licenses and approvals by the government authorities	2	37.30
	Inaccurate Information in the import licenses and approvals by the government authorities	1	16.00
	Delay in the issuance of Delivery Order by the Freight Forwarder	7	167.30
Cash Flow	Payment delay to the bank by the consignee	18	10,907.57
	Payment delay to the broker by the consignee	15	785.20
Physical Flow	Transportation delay due to public holidays	6	519.40
	Transportation delay due to congestion at port	15	698.02
	Transportation delay due to COVID-19 lockdown	1	531.00
Total		70	13,936.79 JOD

C.-H. Chang et al. (2014) classified risks in container shipping operations into three categories: risk associated with information flow, risk associated with physical flow, and risk associated with payment flow. Risk associated with information flow includes information delay, information inaccuracy, and IT problems; risk associated with physical flow includes transportation delay and cargo/asset damage; and risk

DOI: 10.21791/IJEMS.2022.1.9.

associated with payment flow includes currency exchange, payment delay, and non-payment.[24] This research explored 10 causes for the long container dwell time and these causes can be classified based on the mentioned classification as following:

- Causes Related to Information Flow:

Due to information delays, three causes have been identified: delay in sending the set of the shipping documents by the consignor, delay in the issuance of import licenses and approvals by the government authorities, and delay in the issuance of delivery orders by the Freight Forwarder. Due to inaccurate or missing information two causes have been determined: missing information in the set of shipping documents sent by the consignor and inaccurate Information in the import licenses and approvals by the government authorities. No causes have been found due to IT problems.

- Causes Related to Cash Flow:

Two causes have been identified due to payment delay: delay in the consignee's payment to the bank and delay in the consignee's payment to the broker. No causes have been identified due to currency exchange or non-payment.

- Causes Related to Physical Flow:

Three causes due to transportation delay been determined due to transportation delay: transportation delay due to public holidays in Jordan, transportation delay due to congestion at Aqaba port, and transportation delay due to COVID-19 lockdown. No causes have been identified due to cargo/asset damage.

C.-H. Chang et al. (2014) revealed that the risks associated with physical flows have more serious risk impacts than the other types of risks.[24] however, in this research the causes related to cash flow represented approximately 85% of the total cost.

4. Conclusion and Recommendations

The data of import containers whose stay at the terminal exceeded the free storage period was collected by referring to the set of shipping documents and reviewing the correspondences between the consignee and other parties in the supply chain. After analyzing the document collection, clearance process and delivery timelines, ten causes for the long dwell time have been identified and classified into three main categories: causes related to information flow, causes related to cash flow, and causes related to physical flow.

In FCL shipments, the cash flow causes constituted a significant portion of the overall cost. The demurrage and detention charges due to causes related to information flow were 2% of the total cost, 85% due to causes related to cash flow, and 13% due to cases related to physical flow. While the causes related to information flow constituted the major portion of the total expenses in the LCL shipments. The demurrage and detention charges due to causes related to information flow were 84% of the total cost, 8% due to causes related to cash flow, and 8% due to cases related to physical flow.

Further studies can be conducted to propose solutions to reduce the average container dwell time at the terminal's storage yards. This can reduce the total shipping costs for the consignees by avoiding extra demurrage and detention charges as well as improve the ports' terminals productivity and competitiveness.

References

[1] N. Moini, M. Boile, S. Theofanis, and W. Laventhal, "Estimating the determinant factors of container dwell times at seaports," *Marit. Econ. Logist.*, 2012, doi: 10.1057/mel.2012.3.

[2] "Aqaba Company for Ports Operation & Management." http://www.aqabaports.com.jo/EN/INPage.aspx (accessed Mar. 17, 2021).

[3] "Our Terminal - Aqaba Container Terminal." https://www.act.com.jo/en/about-us/about-us (accessed Mar. 17, 2021).

[4] "About Us - Aqaba Logistics Village (ALV)." http://www.alv.jo/AboutUs.aspx (accessed Mar. 17, 2021).

[5] P. Hayaloglu, "The Impact of Developments in the Logistics Sector on Economic Growth: The Case of OECD Countries International Journal of Economics and Financial Issues The Impact of Developments in the Logistics Sector on Economic Growth: The Case of OECD Countries," *Int. J. Econ. Financ. Issues*, vol. 5, no. 2, pp. 523–530, 2015, Accessed: Jan. 28, 2021. [Online]. Available: http:www.econjournals.com.

[6] J. Engblom, T. Solakivi, J. Töyli, L. O.-I. J. of Production, and undefined 2012, "Multiple-method analysis of logistics costs," *Elsevier*, Accessed: Jan. 28, 2021. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0925527312000084?casa_token=xjSqMZVRFasAAAAA:PblZkIZSioxK2I0whmmyRTK4a6UA2SHSRu17QTmnKCfc40rU71J3I6BUbbkb45_zxVLk3Y9zfQ.

[7] J. Mangan and C. Lalwani, *Global logistics and supply chain management*. 2016.

[8] J. T. Mentzer *et al.*, "DEFINING SUPPLY CHAIN MANAGEMENT," *J. Bus. Logist.*, vol. 22, no. 2, pp. 1–25, Sep. 2001, doi: 10.1002/j.2158-1592.2001.tb00001.x.

[9] K. D. Chopra S, Meindl P, *Supply chain management: strategy, planning, and operation.*, 4th ed. Boston, MA: Pearson; 2013 Nov., 2013.

[10] & L. J.-I. J. of P. D. and undefined 2004, "Supply chain logistics risks. From the back room to the board room," *elibrary.ru*, Accessed: Jan. 29, 2021. [Online]. Available: https://elibrary.ru/item.asp?id=6636591.

[11] R. Omar and T. Ramayah, "Information exchange and supply chain performance," *Artic. Int. J. Inf. Technol. Decis. Mak.*, vol. 9, no. 1, pp. 35–52, Jan. 2010, doi: 10.1142/S0219622010003658.

[12] I. F. A. Vis and R. De Koster, "Transshipment of containers at a container terminal: An overview," *Eur. J. Oper. Res.*, 2003, doi: 10.1016/S0377-2217(02)00293-X.

[13] H. Dally, "Container Handling and Transport: A Manual of Current Practice," 1983, Accessed: Jan. 28, 2021. [Online]. Available: https://trid.trb.org/view/393457.

[14] Hoffman P., "Container facility planning: a case description," *Port Manag. Textb. Contain. Inst. Shipp. Econ. Logist.*, pp. 353–364, 1985, Accessed: Jan. 28, 2021. [Online]. Available: https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Hoffman+P.+Container+facility+pla

nning%3A+a+case+description.+Port+management+textbook+containerization%2C+Institute+of+shipping+economics+and+logistics.+1985%3A353-64.&btnG=.

[15] F. Merckx, "The Issue of Dwell Time Charges to Optimize Container Terminal Capacity," *IAME 2005 Annu. Conf.*, 2005.

[16] J. P. Rodrigue and T. Notteboom, "The terminalization of supply chains: Reassessing the role of terminals in port/hinterland logistical relationships," *Marit. Policy Manag.*, 2009, doi: 10.1080/03088830902861086.

[17] Nathan Huynh, "Analysis of container dwell time on marine terminal throughput and rehandling productivity," *J. Int. Logist. Trade*, vol. 6, no. 2, pp. 69–89, 2008, Accessed: Jun. 13, 2021. [Online]. Available: https://www.dbpia.co.kr/Journal/articleDetail?nodeId=NODE01770925#.

[18] S. Y. Huang, W. J. Hsu, C. Chen, R. Ye, and S. Nautiyal, "Capacity analysis of container terminals using simulation techniques," *Int. J. Comput. Appl. Technol.*, vol. 32, no. 4, pp. 246–253, 2008, doi: 10.1504/IJCAT.2008.021379.

[19] I. Kourounioti, A. Polydoropoulou, and C. Tsiklidis, "Development of Models Predicting Dwell Time of Import Containers in Port Container Terminals - An Artificial Neural Networks Application," in *Transportation Research Procedia*, Jan. 2016, vol. 14, pp. 243–252, doi: 10.1016/j.trpro.2016.05.061.

[20] S. Fazi and K. J. Roodbergen, "Effects of demurrage and detention regimes on dry-port-based inland container transport," *Transp. Res. Part C Emerg. Technol.*, 2018, doi: 10.1016/j.trc.2018.01.012.

[21] "Tariffs - Aqaba Container Terminal." https://www.act.com.jo/en/practical-information/tariffs (accessed Apr. 14, 2021).

[22] "LCL Tariff." http://www.alv.jo/LCLTariff.aspx (accessed Apr. 14, 2021).

[23] "WHO/Europe | Coronavirus disease (COVID-19) outbreak - About the virus." https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/novel-coronavirus-2019-ncov (accessed May 25, 2021).

[24] C. H. Chang, J. Xu, and D. P. Song, "Risk analysis for container shipping: From a logistics perspective," *International Journal of Logistics Management*. 2015, doi: 10.1108/IJLM-07-2012-0068.