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Equipment Reposition Optimization

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Resumen

Las líneas marítimas necesitan un flujo continuo de equipos para mantener su servicio, competencia y operaciones en el sector logístico y cadena de suministro. El escenario ideal es lograr que cada contenedor que sea devuelto vacío al recinto portuario sea utilizado para una exportación en un corto periodo de tiempo. Los costos de reposicionamiento comienzan inmediatamente después que el contenedor ha sido retornado vacío al depósito o recinto portuario y aumentan progresivamente con el paso de los días en caso tal que el mismo no sea utilizado.

Las líneas marítimas asumen estos costos por un periodo de tiempo en base al contrato que tengan con la Terminal Portuaria, pero al final son los productores y consumidores finales quienes pagan el precio de esta sobre estadía que se traduce como una ineficiencia. El problema se genera cuando los analistas de precio cotizan el reposicionamiento del equipo según una regla previamente establecida en lugar de comprender lo que realmente está sucediendo, para así cotizar en base a cada situación particular. Por ende, existe la necesidad de identificar los desequilibrios de los equipos y planificar un reposicionamiento con costos y tiempos de tránsito mínimos. Todo lo anterior nos lleva a la estrategia comercial de tratar de obtener crédito por reposición basado en una exportación desde un recinto donde haya un exceso de equipo hacia uno donde haya una deficiencia y exista una alta demanda del mercado haciendo uso de la tarifa que paga el embarcador. Este estudio busca desarrollar estrategias de optimización de reposición de equipos para beneficiar a una línea marítima regional, con operaciones en Panamá, en aspectos tales como: mejor control de inventario y evitar contribuciones negativas al ganar más volumen de carga como consecuencia de ofrecer tarifas más competitivas de las cuales el consumidor final se verá directamente beneficiado.

Palabras clave: *Líneas marítimas, Flujo continuo, Optimización de procesos, Estrategia comercial, Costos de reposicionamiento económico*.

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Abstract

Maritime Lines need the continuous equipment flow to maintain their service and operations among the port network they call. The ideal scenario for a shipping company would be every inbound container exported as a full container loaded in a short term. Reposition costs begin right after the container has been discharged and it will increase every day if the unused unit stays in a depot. The Maritime Lines will beard these costs for a while to quicken the process, but in the end, producers and consumers will pay all. This project is being undertaken because it is necessary to identify equipment imbalances and plan equipment repositioning with minimum costs and transit times, besides trying to get credit for
export cargoes by import units using the drop off fee paid by the shipper. This way, better equipment control, which will benefit the customers, will be obtained. This strategy will help companies to avoid negative contributions by earning more cargo volume and offering competitive rates.

Keywords: *Maritime lines, Continuous flow, Process optimization, Commercial strategy, Economic repositioning costs*.

Introduction

The goal with foreign-to-foreign pricing (between secondary ports) is to provide the major lanes with additional revenue by securing business carried on the backhaul trades.

Despite the backhaul being just an additional income for a major trade line, it is valid to believe that by setting up an organized pricing strategy for backhaul trades, the revenue can be maximized.

Foreign to foreign pricing is based on a three-level pricing strategy:

<u>Level 1: Public Tariff</u>

- Pre-approved rates
- Highest rate
- Initial offer
- Permanent in system

<u>Level 2: Special Tariff</u>

- Pre-approved special rates
- Mid-level rate
- Only approved after certain criteria have been met
- Never filed as permanent

<u>Level 3: Spot Rates</u>

- Rate lower than level 2

- Only approved after certain criteria have been met
- Never filed as permanent
- Used to match competition rates when required.

PRICING RATE STRUCTURE

The rates from each pricing level are structured identically (costs + income):

- Stevedoring: load, discharge, transship
- Slot costs: connecting carrier slot costs (feeders)
- Repositioning: returning the empty equipment container to a selected country
- Slot Rate: Company's income
- Agency Commissions

The difference between each pricing level is determined by costs and slot rate level applied:

Level 1:

- Stevedoring Rates and Level 1 Slot Rate

Level 2:

- Stevedoring Rates (same as Level 1) but Level 2 Slot Rate, which is lower than Level 1 Slot Rate

Level 3:

- Stevedoring Costs. The Slot Rate for Level 3 is the result of the sum of costs minus the rate the company needs to match

Level 1 (Public)	**Level 2 (Special)**	**Level 3 (Spot)**
Pol Stevedoring Rates	Pol Stevedoring Rates	Pol Stevedoring Costs
T/S Stevedoring Rates	T/S Stevedoring Rates	T/S Stevedoring Costs
Pod Stevedoring Rates	Pod Stevedoring Rates	Pod Stevedoring Costs
Slot Costs (when applicable)	Slot Costs (when applicable)	Slot Costs (when applicable)
Repositioning	Repositioning	Repositioning (when applicable)
Slot Rate (Level 1)	Slot Rate (Level 2)	Slot Rate (Costs – Match Rate)
Agency Commissions	Agency Commissions	Agency Commissions (when applicable)

Table 1. Pricing Rate Structure

Definitions
Pol: Port of Loading T/S: Transshipment Port Pod: Port of Discharge

The difference between Level 1 and Level 2 pricing is the Slot Rate; meanwhile in Level 3 all items make the difference.

CONTAINER PRICING

COSTS DEFINITION

1. Stevedoring
    - Stevedoring Costs: Company's actual costs (or as close as possible to actual costs) rounded. For Level 3 (Spot Rate) these costs are increased to the nearest integer.
    - Stevedoring Rates: Stevedoring costs are rounded, which means they are increased to the nearest $50.00. Applied on Level 1 (Public Rate) and Level 2 (Special Rate).

    Stevedoring costs have been obtained and updated throughout the years by asking offices and agents. Recently a sharing information process has been started to have the most updated costs.

2. Slot Costs
    Costs generated when purchasing slots from a connecting carrier. They are only applied when a connecting carrier is required to complete a service. Slot costs are applied to all pricing levels without exceptions.

    Frequent connecting carriers:
    - Caribbean Feeder Service (CFS)
    - Xpress Feeder Service (XPF)
    - Maersk (MSK)
    - Hyde Shipping (HYD)
    - Tropical Shipping (TRO)
    - Don Andres (DON)
    - Seven Castle (SVT)
    - Betty K (BTK)

    These costs are not rounded; they are applied exactly as provided in Connecting Carrier Agreements.

3. Repositioning Costs
    Reposition is divided into two categories:
    - Stevedoring: to apply the correct stevedoring level for loading, transshipping and discharging the empty container.

- Return Country:
    - For Level 1 and Level 2 Pricing the default country is USA (mainly Houston or Miami)

4. Agency Commissions
As a default, a 7.5% agency commission's fee will be applied to all Level 1 and Level 2 rates. The 7.5% fee is broken down as 5% for exports and 2.5% for imports. When calculating a Level 3 rate, we will apply the agency commission only when it is applicable.

5. Slot Rates
A back-haul trade can be handled partially or entirely by Seaboard Marine operated vessels or by a connecting carrier, so there have been established Slot Rates to both cases. These rates are not established by a mathematical calculation; instead themarket determines the rates.

   Therefore, to be more competitive, the company has created a Slot Rate Transshipment adjustment that is only applicable when connecting ports and destinations ports are back-haul trades. For head haul connecting ports and destination ports the full head haultrade Slot Rate will be applied. When a relay vessel is a connecting carrier vessel, the company will not apply Transshipment Slot Rate adjustment, rather the total Slot Cost from the connecting carrier is applied.

DECISION-MAKING PROCESS

There are some requirements needed to make a pricing decision such as how, when, and whyto offer a Special Rate, Spot Rate and/or decline a request.

So the pricing decision process has been classified into three levels as follows:

a. Basic Pricing: handled by pricing analysts and pricing managers
b. Intermediate Pricing and Rate Renewals/ Extensions: handled by pricing analysts and pricing managers
c. Advanced Pricing: handled by pricing managers only

Pricing analyst responsibility will end at intermediate pricing, which is the limit for Level 2 Pricing. Beyond the intermediate pricing, the pricing analyst will require the approval of a pricingmanager. This approval is also subject to a set of requirements needed before deciding.

EQUIPMENT REPOSITION OPTIMIZATION

Once the container merchandise is discharged, the shipping line/consignee must hire another transport for returning the empty container to the port or shipping company depot.The cost for this service represents the same rate for moving a full container; because if it is loaded or not it consumes the same amount of space and therefore requires the same transport capacity.

To summarize, every arrived container, as an import to any country must be eventually exported, either empty or full, because the longer the unit stays, the costs for the company will be higher. Maritime Lines need the continuous equipment flow to maintain their service and operations among the port network they call. The ideal scenario for a shipping company would be every inbound container will be exported as FCL (Full Container Loaded) in a short term.

Reposition costs begin right after the container has been discharged and it will increase every day if the unused unit stays in a depot. The Maritime Lines will beard these costs for a while to quicken the process, but in the end, producers and consumers will pay all. Nowadays, an increasing number of containers are repositioned empty because cargo cannot be found for a return leg. In consequence, the repositioning costs increased, but Maritime Lines attempt to manage the container utilization level of their assets, so the positioning of empty containers is one of the most complex problems concerning global freight distribution.

The major causes involved in this situation:

- Trade imbalances: this happens when a region or a country imports more than it exports so it will face the systematic accumulation of empty containers. On the other hand, whena region or a country exports more than it imports it will face a shortage of containers. In the second situation, a repositioning of large amounts of containers will be required, involving higher transportation costs and tying up existing distribution capacities.
- Manufacturing and leasing costs: if the costs of manufacturing new containers, or leasing existing units, are cheaper than repositioning them, which can be possible over long distances, then an accumulation can happen. Inversely, higher manufacturing or leasing costs may favor the repositioning of empty containers. In conclusion, a condition tends to be temporary as leasing costs and imbalances are correlated.
- Slow steaming: rising bunker fuel prices have incited Maritime Lines to reduce the operational speed of their containership. The resulting longer transoceanic journeys tie more container inventory in transit and reduce the availability of containers in many countries.

Based on the above information, implementing the Equipment Reposition Optimization tool will minimize the Shipping Lines operational costs and benefit importers, exporters and ultimately the consumer with lower shipping rates.

The business challenge to achieving cost savings lies in the ability to handle the complexities surrounding the equipment types, subjective forecasts and access to the right information at the right time.

The stakeholders of this optimization will be: shipping companies, shippers, consignees, stevedoring companies and trucker companies. Therefore, the most important benefit will be to reduce costs by increasing cargo volume and acquiring more customers.

IMBALANCE IDENTIFICATION

According to the decision-making process, most pricing analysts are not aware of which is the optimum destination for the empty units, so as a consequence they are quoting more expensive than other pricing analysts and the company is losing business.

Also, next year Shipping Lines will be facing the most expensive regulation that the international shipping industry has ever seen (IMO 2020), which stems from a Sulphur reduction of the bunker. To handle this operational cost increase, several strategies for cost recovery should be developed. Thus if the Equipment Reposition Optimization tool is implemented for all Lines, the final consumer of each country, including Panama, will be spared all/or some of the direct effect of these cost increases.The best way to analyze the problem is to focus on ports that have critical imbalances and tostudy the vessel rotation in which these ports are involved.

Therefore, it is important to know that in a vessel rotation exists two types of routes:

- Primary Route: is the one who has United States ports as Port of Loading, for example, Miami to Kingston or Houston to Manzanillo. These routes are the one who pays the whole vessel rotation.
- Secondary Route: is the one who gives to the company an extra profit because thewhole rotation is already paid and doesn't include any US port, for example, Cartagena and Barranquilla to Rio Haina or Guayaquil to Puerto Cortes.

This report will analyze three critical imbalances using the data shown from Table 2 to Table 10 to decide which is the worst based on unit reutilization percentage calculation.

$$\% \text{ Unit Reutilization} = (\text{Export Full}/ \text{Import Full})*100$$

The next step is to study the different vessels rotations in this worst critical imbalanced port is involved and improve on it.

PUERTO MOIN (COSTA RICA)

Import Full				
Year	**Month**	**20 DRY CON**	**40 DHC CON**	**40 REF CON**
2019	Mar	81	252	100
	Apr	199	808	270
	May	120	756	207
	Jun	132	630	211
	Jul	165	776	241
	Aug	127	658	194
	Sep	116	699	225
	Oct	94	609	157
Total		**1034**	**5188**	**1605**

Table 2. Import Full Puerto Moin

Export Full				
Year	**Month**	**20 DRY CON**	**40 DHC CON**	**40 REF CON**
2019	Mar	87	361	190
	Apr	151	680	586
	May	208	721	607
	Jun	242	763	497
	Jul	205	710	604
	Aug	205	717	528
	Sep	158	753	451
	Oct	120	504	336
Total		**1376**	**5209**	**3799**

Table 3. Export Full Puerto Moin

Unit Reutilization (IM/EX)				
Year	**Month**	**20 DRY CON**	**40 DHC CON**	**40 REF CON**
2019	Mar	**107%**	**143%**	**190%**
	Apr	76%	84%	**217%**
	May	**173%**	95%	**293%**
	Jun	**183%**	**121%**	**236%**
	Jul	**124%**	91%	**251%**
	Aug	**161%**	**109%**	**272%**
	Sep	**136%**	**108%**	**200%**
	Oct	**128%**	83%	**214%**
	Average	136%	104%	234%

Table 4. Unit Reutilization Puerto Moin

GUAYAQUIL (ECUADOR)

Import Full				
Year	**Month**	**20 DRY CON**	**40 DHC CON**	**40 REF CON**
2019	Jan	35	123	13
	Feb	123	422	61
	Mar	164	603	66
	Apr	90	332	159
	May	165	375	140
	Jun	159	452	192
	Jul	144	344	156
	Aug	178	758	85
	Sep	158	552	63
	Oct	106	401	43
Total		**1322**	**4362**	**978**

Table 5. Import Full Guayaquil

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Export Full				
Year	**Month**	**20 DRY CON**	**40 DHC CON**	**40 REF CON**
2019	Jan	10	72	181
	Feb	61	422	753
	Mar	58	401	885
	Apr	99	273	749
	May	196	328	980
	Jun	84	344	791
	Jul	80	285	784
	Aug	70	411	949
	Sep	58	373	752
	Oct	43	210	497
Total		**759**	**3119**	**7321**

Table 6. Export Full Guayaquil

Unit Reutilization (IM/EX)				
Year	**Month**	**20 DRY CON**	**40 DHC CON**	**40 REF CON**
2019	Jan	29%	59%	**1,392%**
	Feb	50%	100%	**1,234%**
	Mar	35%	67%	**1,341%**
	Apr	**110%**	82%	**471%**
	May	**119%**	87%	**700%**
	Jun	53%	76%	**412%**
	Jul	56%	83%	**503%**
	Aug	39%	54%	**1,116%**
	Sep	37%	68%	**1,194%**
	Oct	41%	52%	**1,156%**
	Average	57%	73%	952%

CALLAO (PERU)

Import Full				
Year	Month	20 DRY CON	40 DHC CON	40 REF CON
2019	Jan	16	118	5
	Feb	148	422	35
	Mar	135	385	31
	Apr	130	388	91
	May	145	364	48
	Jun	155	407	69
	Jul	146	478	86
	Aug	155	382	57
	Sep	163	439	61
	Oct	117	449	68
Total		1310	3832	551

Table 8. Import Full Callao

Export Full				
Year	Month	20 DRY CON	40 DHC CON	40 REF CON
2019	Jan	46	62	32
	Feb	265	340	79
	Mar	106	252	51
	Apr	234	305	92
	May	213	229	89
	Jun	282	260	177
	Jul	175	235	609
	Aug	230	292	277
	Sep	195	201	210
	Oct	165	233	187
Total		1911	2409	1803

Table 9. Export Full Callao

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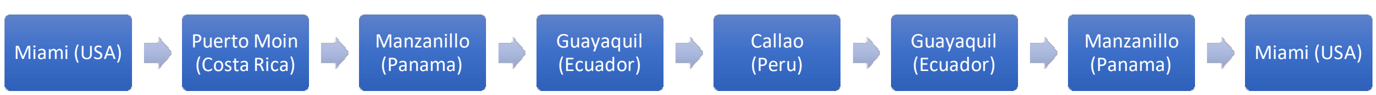
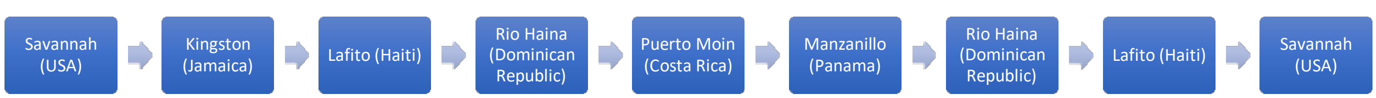
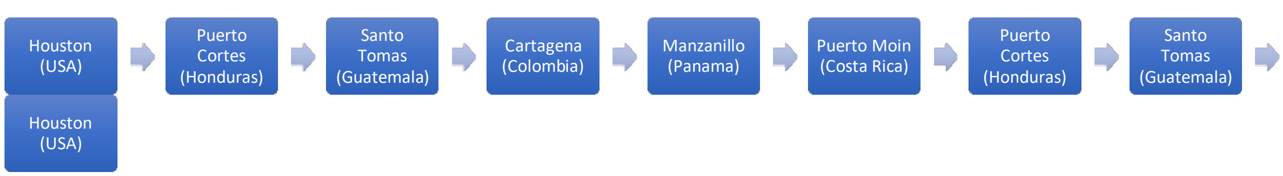
Unit Reutilization (IM/EX)				
Year	Month	20 DRY CON	40 DHC CON	40 REF CON
2019	Jan	**288%**	53%	**640%**
	Feb	**179%**	81%	**226%**
	Mar	79%	65%	**165%**
	Apr	**180%**	79%	**101%**
	May	**147%**	63%	**185%**
	Jun	**182%**	64%	**257%**
	Jul	**120%**	49%	**708%**
	Aug	**148%**	76%	**486%**
	Sep	**120%**	46%	**344%**
	Oct	**141%**	52%	**275%**
	Average	144%	57%	308%

Table 10. Unit Reutilization Callao

According to information above Puerto Moin (Costa Rica) is the one who has the worst equipment imbalance.Puerto Moin is involved in three different vessel rotations that are:







The following tables (from Table 11 to Table 13) are examples of primary and secondary routes of each rotation:

Primary Routes	Secondary Routes
Miami to Puerto Moin	Puerto Moin to Manzanillo
Miami to Manzanillo	Puerto Moin to Guayaquil
Miami to Guayaquil	Puerto Moin to Callao
Miami to Callao	Callao to Guayaquil
	Guayaquil to Callao
	Manzanillo to Callao
	Manzanillo to Guayaquil

Table 11. Rotation 1

Primary Routes	Secondary Routes
Savannah to Kingston	Kingston to Rio Haina
Savannah to Rio Haina	Rio Haina to Puerto Moin
Savannah to Puerto Moin	Puerto Moin to Manzanillo
Savannah to Manzanillo	Manzanillo to Rio Haina
	Rio Haina to Manzanillo
	Manzanillo to Puerto Moin
	Puerto Moin to Rio Haina

Table 12. Rotation 2

Primary Routes	Secondary Routes
Houston to Puerto Cortes	Puerto Cortes to Manzanillo
Houston to Santo Tomas	Puerto Cortes to Puerto Moin
Houston to Cartagena	Puerto Cortes to Cartagena
Houston to Manzanillo	Cartagena to Manzanillo
Houston to Puerto Moin	Cartagena to Puerto Cortes
	Cartagena to Santo Tomas
	Manzanillo to Puerto Cortes

Table 13. Rotation 3

When a pricing analyst is quoting repositioning costs, the fundamental rule is to return empty containers to main ports such as Miami, Houston, New Orleans or any other port located in the

United States. This operational cost is about US$600 and not in all cases these main ports are demanding empty units. On the other hand, repositioning empty containers between secondary routes ports is cheaper because the cost is half, so, in this case, it would be US$300.To better understand this process it is recommended to focus on the ports that have an excess of empty units and the ones who have an insufficiency of those units to create a balance.

In the bellow table it would be appreciated the equipment flow on this vessel rotations, but first it is important to contemplate that when a unit reutilization is greater than 60% there exists an empty equipment balance, otherwise if is less than 50% then is empty equipment excess and finally if the percentage is greater than 100% which is mathematically impossible means there is empty equipment deficit. So, in Tables 14 and 15 can be appreciated the different equipment cases.

Unit Reutilization Import/ Export			
Port (County)	20DC	40DC	40RF
Puerto Moin (Costa Rica)	136%	104%	234%
Guayaquil (Ecuador)	57%	73%	952%
Callao (Peru)	144%	57%	308%
Kingston (Jamaica)	25%	12%	41%
Rio Haina (Dominican Republic)	25%	36%	48%
Puerto Cortes (Honduras)	139%	87%	264%
Santo Tomas (Guatemala)	93%	70%	215%
Cartagena (Colombia)	128%	120%	22%
Lafito (Haiti)	4%	11%	16%

Table 14. Unit Reutilization Import/ Export Yearly

Unit Excess/ Deficit Quantity			
Port (County)	20DC	40DC	40RF
Puerto Moin (Costa Rica)	342	21	2,194
Guayaquil (Ecuador)	563		6,343
Callao (Peru)	601	1,429	1252
Kingston (Jamaica)	2,615	9,940	902
Rio Haina (Dominican Republic)	3,720	12,644	1,279
Puerto Cortes (Honduras)	414		1,952
Santo Tomas (Guatemala)			4,089
Cartagena (Colombia)	293	641	629
Lafito (Haiti)	2,086	3,463	451

Table 15. Unit Excess/ Deficit Quantity Yearly

IMBALANCE OPTIMIZATION

Equipment Reposition Optimization can be solved using the Transportation Problem model because it meets the following characteristics:

- Items are transported from a number of sources to a number of destinations at minimum cost
- Each source supplies a fixed number of units
- Each source destination has a fixed demand for units

In this case, performing monthly analysis will solve the 20DC yearly imbalance by followingthese steps:

1. Perform Import/ Export report to decide which will be the capacity and demand.
   - If export quantity – import quantity > 0 then we have excess (Capacity)
   - If export quantity – import quantity > 0 then we have deficit (Demand)
2. Establish destination ranking according to shortest and longest transit time because the transport cost is the same for each case. It will be settled from 1 to 4.
   In this report the setup priorities are:
   - Guayaquil to Callao
   - Kingston to Puerto Moin and Puerto Cortes
   - Rio Haina to Callao
   - Lafito to Cartagena
3. Setup the problem with all its inputs
4. Establish constraints:
   - To make sure that the total amount of products sent from each origin does not exceed its capacity
   - To make sure that the total amount of products arriving at each destination is enough
   - To make sure of non-negativity constraints
5. Calculate:
   - Capacity excess = capacity units – current demand
   - Total Cost of Optimized Repositioning = (Total Capacity excess*$600) + (TotalDemand*$300)
   - Total Cost of Current Repositioning = Total Capacity*$600 (According to rule)
   - Total Saving = Total Cost of Current Repositioning – Total Cost of OptimizedRepositioning

Analyze unit percentage required to meet the demand and create a reposition rule that improves current imbalance problem and saves money.

In each transport problem setup monthly, the established ranking is the same as it is shown in

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Table 16. The ranking considers the best transit time according to different port locations:

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	2	1	2	2
Kingston	1	2	1	2
Rio Haina	2	1	2	2
Lafito	2	2	2	1

Table 16. Secondary Port

Then the equipment reposition optimization and the total saving are calculated using a model month by month. In this case the sample size is conformed by eight months due to the raw data,which was cut in half on January and October. Tables 17 to 24 show how the model works .

FEBRUARY

Table 17. February Optimization

Decision Variables

	Puerto Moin	Callao	Puerto Cortes	Cartagena	Capacity Constraints		Capacity	Excess Units
Guayaquil	0	62	0	0	62	<=	62	0
Kingston	42	0	5	0	47	<=	236	189
Rio Haina	0	55	0	0	55	<=	300	245
Lafito	0	0	0	52	52	<=	294	242
Demand	42	117	5	52				
	>=	>=	>=	>=				
	42	117	5	52				

Objective Function	221
Total Cost of Optimized Repositioning	$ 470,400.00
Current Cost of Repositioning	$ 535,200.00
Total Saving	$ 64,800.00

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0%	100%	0%	0%
Kingston	18%	0%	2%	0%
Rio Haina	0%	18%	0%	0%
Lafito	0%	0%	0%	18%

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MARCH

Decision Variables

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0	0	0	0
Kingston	6	0	0	0
Rio Haina	0	0	0	0
Lafito	0	0	0	14
Demand	6	0	0	14
	>=	>=	>=	>=
	6	0	0	14

Capacity Constraints		Capacity	Excess Units
0	<=	106	106
6	<=	297	291
0	<=	453	453
14	<=	223	209

Objective Function	20
Total Cost of Optimized Repositioning	$ 641,400.00
Current Cost of Repositioning	$ 647,400.00
Total Saving	$ 6,000.00

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0%	0%	0%	0%
Kingston	2%	0%	0%	0%
Rio Haina	0%	0%	0%	0%
Lafito	0%	0%	0%	6%

Table 18. March Optimization

APRIL

Decision Variables

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0	0	0	0
Kingston	0	0	0	0
Rio Haina	0	104	0	0
Lafito	0	0	0	43
Demand	0	104	0	43
	>=	>=	>=	>=
	0	104	0	43

Capacity Constraints		Capacity	Excess Units
0	<=	0	0
0	<=	343	343
104	<=	349	245
43	<=	144	101

Objective Function	147
Total Cost of Optimized Repositioning	$ 457,500.00
Current Cost of Repositioning	$ 501,600.00
Total Saving	$ 44,100.00

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0%		0%	0%
Kingston	0%	0%	0%	0%
Rio Haina	0%	30%	0%	0%
Lafito	0%	0%	0%	30%

Table 19. April Optimization

MAY

Decision Variables	Puerto Moin	Callao	Puerto Cortes	Cartagena		Capacity Constraints		Capacity		Excess Units
Guayaquil	0	0	0	0		0	<=	0		0
Kingston	88	0	103	0		191	<=	285		94
Rio Haina	0	68	0	0		68	<=	437		369
Lafito	0	0	0	0		0	<=	279		279
Demand	88	68	103	0						
	>=	>=	>=	>=						
	88	68	103	0						
Objective Function	362									
Total Cost of Optimized Repositioning		$ 522,900.00								
Current Cost of Repositioning		$ 600,600.00								
Total Saving		$ 77,700.00								

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0%	100%	0%	0%
Kingston	18%	0%	2%	0%
Rio Haina	0%	18%	0%	0%
Lafito	0%	0%	0%	18%

Table 20. May Optimization

JUNE

Decision Variables

	Puerto Moin	Callao	Puerto Cortes	Cartagena	Capacity Constraints		Capacity	Excess Units
Guayaquil	0	0	0	0	0	<=	75	75
Kingston	110	0	75	0	185	<=	265	80
Rio Haina	0	127	0	0	127	<=	379	252
Lafito	0	0	0	28	28	<=	173	145

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Demand	110	127	75	28
	>=	>=	>=	>=
	110	127	75	28

Objective Function	415
Total Cost of Optimized Repositioning	$ 433,200.00
Current Cost of Repositioning	$ 535,200.00
Total Saving	$ 102,000.00

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0%	100%	0%	0%
Kingston	18%	0%	2%	0%
Rio Haina	0%	18%	0%	0%
Lafito	0%	0%	0%	18%

Table 21. June Optimization

JULY

Decision Variables

	Puerto Moin	Callao	Puerto Cortes	Cartagena	Capacity Constraints		Capacity	Excess Units
Guayaquil	0	0	0	0	0	<=	64	64
Kingston	40	0	19	0	59	<=	297	238
Rio Haina	0	29	0	0	29	<=	398	369
Lafito	0	0	0	92	92	<=	257	165

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Demand	40	29	19	92
	>=	>=	>=	>=
	40	29	19	92

Objective Function	199
Total Cost of Optimized Repositioning	$ 555,600.00
Current Cost of Repositioning	$ 609,600.00
Total Saving	$ 54,000.00

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0%	100%	0%	0%
Kingston	18%	0%	2%	0%
Rio Haina	0%	18%	0%	0%
Lafito	0%	0%	0%	18%

Table 22. July Optimization

AUGUST

Decision Variables

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0	75	33	0
Kingston	78	0	186	0
Rio Haina	0	0	0	0
Lafito	0	0	0	12
Demand	78	75	219	12
	>=	>=	>=	>=
	78	75	219	12
Objective Function	603			

Total Cost of Optimized Repositioning	$ 628,200.00
Current Cost of Repositioning	$ 743,400.00
Total Saving	$ 115,200.00

Capacity Constraints		Capacity	Excess Units
108	<=	108	0
264	<=	322	58
0	<=	520	520
12	<=	289	277

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0%	100%	0%	0%
Kingston	18%	0%	2%	0%
Rio Haina	0%	18%	0%	0%
Lafito	0%	0%	0%	18%

Table 23. August Optimization

SEPTEMBER

Decision Variables

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0	32	68	0
Kingston	42	0	27	0
Rio Haina	0	0	0	0
Lafito	0	0	0	44
Demand	42	32	95	44
	>=	>=	>=	>=
	42	32	95	44
Objective Function	308			

Total Cost of Optimized Repositioning	
Current Cost of Repositioning	
Total Saving	$ 63,900.00

Capacity Constraints		Capacity	Excess Units
100	<=	100	0
69	<=	285	216
0	<=	453	453
44	<=	314	270

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0%	100%	0%	0%
Kingston	18%	0%	2%	0%
Rio Haina	0%	18%	0%	0%
Lafito	0%	0%	0%	18%

Table 24. September Optimization

Less than 20% of the units are needed to balance some critical ports so the other 80% can be returned to the United States where the main ports are.

Guayaquil is an exception, so this port can be considered as an empty distribution center to South American countries, thus operational costs will be reduced and businesses are going to be secured. For example, the shipping of plastic articles from Callao to Lafito or the general merchandise export from Cartagena to Rio Haina.

In the meantime, the company will be acquiring new customers due to its competitive rates.

As it is shown a cumulative total saving is achieved monthly so there is a graphic to compare the optimized cost with the current.

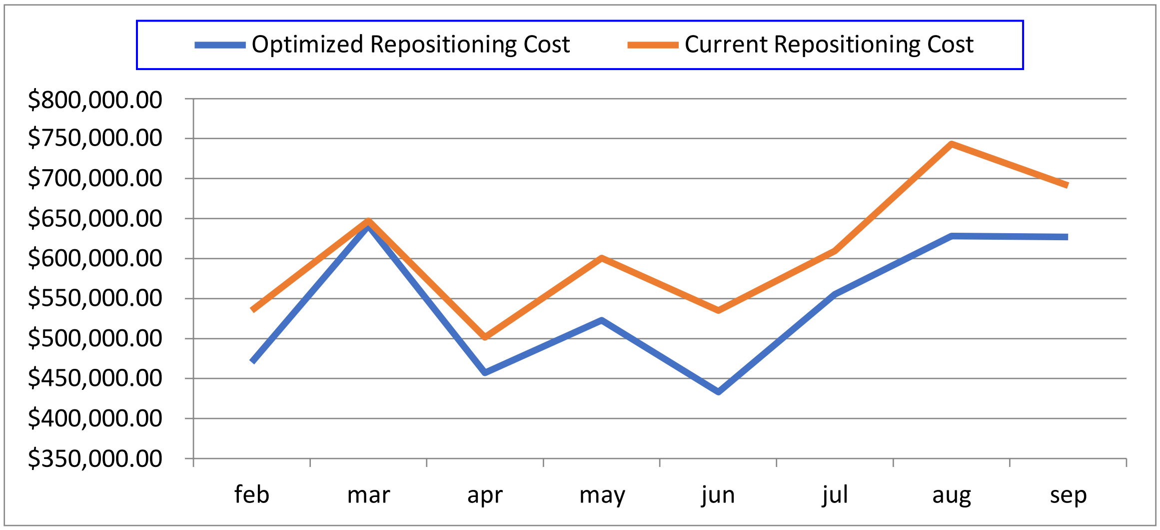

Table 25. Optimization Repositioning Cost vs. Current Repositioning Cost

As can be seen from Table 25, implementing Equipment Reposition Optimization tool has the potential to improve current imbalances in a shorter period of time while the company saves money on operational costs.

Total Cost of Optimized Repositioning	$4,336,500.00
Current Cost of Repositioning	$4,864,200.00
Total Saving	$527,700.00

As can be seen from Table 26, an Input-output form has been created to allow pricing analysts to calculate monthly optimization in a user-friendly way. Instructions have been settled to avoid confusion or wasting time. The capacity and demand must be concluded after performing Import/ Export reports.

Calculate button shows equipment quantity distribution from each port of loading to each port of discharge and equipment distribution percentage to make users able to establish a rule change.On the other hand, the Clear Input button just clear inputs, such as capacity, demand, and ranking. At the bottom of the spreadsheet will be appreciated the current reposition cost, optimized reposition, and total saving.

	Puerto Moin	Callao	Puerto Cortes	Cartagena		Capacity
Guayaquil	2	1	2	2		100
Kingston	1	2	1	2		400
Rio Haina	2	1	2	2		150
Lafito	2	2	2	1		280
Demand	500	20	100	80		

Calculate

Clear Input

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0	20	50	0
Kingston	350	0	50	0
Rio Haina	150	0	0	0
Lafito	0	0	0	80

Equipment Distribution Quantity

Equipment Distribution Percentage

	Puerto Moin	Callao	Puerto Cortes	Cartagena
Guayaquil	0%	20%	50%	0%
Kingston	88%	0%	13%	0%
Rio Haina	100%	0%	0%	0%
Lafito	0%	0%	0%	29%

Total Cost of Optimized Repositioning	$ 348,000.00
Current Cost of Repositioning	$558,000.00
Total Saving	**$210,000.00**

Table 26. Input-Output Form

Conclusion

To warranty the continuous development and success of a company, it is important to review processes regularly.

The origin of the actual issue is that all pricing analysts quote equipment reposition under the previously established rule instead of understanding what is going on. This rule consists of always shipping the empty equipment to the United States where the main ports are, but in mostcases, this rule doesn't make sense because there exists another nearest port that has anempty equipment deficit, which needs these units. By repositioning units between secondary ports we can save half of money and time.

The most critical imbalances that were discovered during the confection of this report were at Callao (Peru), Puerto Moin (Costa Rica), and Cartagena (Colombia), so it is important to solve them to start saving operational costs that are eventually handled by consumers.

If Maritime Line achieves operational costs saving it would be able to increase customer satisfaction, volume, and loyalty. This report proposes to make a change of the actual rule and suggests shipping a maximum of 20% of the empty units to the nearest countries that most need it. On the other hand, the rest can be shipped to the United States. Additionally, weekly conferences between countries that have empty excess and deficit can be done to make people aware of the current situation in the company.

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