Maximizing Profits in a Warehouse and Distribution Business using Segmentation Analysis

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ABSTRACT

In 2019 most of sponsor company's transactions came from its freight forwarding service. Due to strategic alliances between retail giants and freight carriers, the profit margins of independent freight forwarders are being squeezed. To survive the company needs to ensure that its warehousing and distribution services are sufficiently profitable. However, company's existing accounting methodology does not show profitability by operations. This project develops a transaction-level cost and revenue allocation model and applies a profit-mapping technique to identify profitability of the business units, customers and services. A more granular analysis revealed the key profit levers which can be deployed to grow company's profits. The profit mapping showed that most customers responsible for higher-than-average gross margins do not have higher profits due to intensive use of fixed-cost resources. To maximize profits the company should target reduction of specific cost items, bundle unprofitable services with profitable ones, and exercise caution in pruning customers.

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1 INTRODUCTION

1.1 Introduction and motivation for the study

The sponsor company of this capstone project, Interport Logistics USA, (the **Company**) is an international third-party logistics (3PL) provider, providing ocean, air and ground freight forwarding, warehousing, and distribution services from a 230,000 square foot warehouse in Miami, Florida (Interport Logistics US. [n.d.]). It also has operating interests in Aruba and Curacao for US and European-based clients.

Interport's portfolio of services in export, import, and e-commerce is provided to hundreds of clients, generating over 68,000 warehouse receipts per year. The key activities involved in these value-added services are picking, packing, distribution, and customs clearance. In 2019, these services generated $4.2M profit, which constituted 40% of the total profits. The remaining 60% of profits were generated by the freight forwarding service, which is seen as the core business of the Company.

However, Interport's management believes that the profitability of its freight forwarding services will decline going forward because strategic alliances between major logistics and retail companies (e.g., Alibaba and Kuehne + Nagel (Marle, 2017)) led to consolidation of ocean carriers in the past few years and reduction of the margins in the 3PL industry (Knowler, 2019). To maintain profitability and compete in a more demanding commercial environment, Interport is under pressure to improve the profitability of its value-added services, which it provides in addition to its freight forwarding business.

The Company's commercial strategy to date has been to increase sales through active marketing of its core services as well as new products. The increase in revenue came with a significant demand on the Company's resources but did not guarantee an increase in the profits. Interport Logistics recognizes the need to understand which services generate the highest profits and to

build on them. This approach requires an analysis of the customer base to identify the most lucrative customers and the services they utilize the most.

1.2 Problem statement

One of the challenges encountered by Interport in leveraging the segmentation of services and customers is that its key performance indicators (KPIs) and the profit and loss (P&L) accounting are centered around its legacy freight forwarding business. The Company often markets its Warehousing and Distribution services as auxiliary to the freight forwarding. Consequently, the income from such bundled services is attributed to freight forwarding, with other business units appearing as loss-making. This method of bookkeeping prevents the Company from accurately identifying what operations and customers generate the highest profits and what new services should be developed to produce the highest returns. To enable such an analysis, the Company needs to have a good understanding of the underlying business costs and revenues generated from a given customer.

The demand for Warehousing and Distribution services was growing in the last three years, and in 2020 the COVID-19 pandemic drove the demand even higher. The increased reliance on Warehousing and Distribution services has forced Interport to accelerate the segmentation of its customers and services to understand the key drivers of higher profit margins. To this end, Interport decided to run a pilot profitability analysis on the warehousing business unit in Miami, Florida, which operates two multi-purpose warehouses. Interport expects the profitability analysis to inform its decision on how to grow the Warehousing and Distribution business. Currently the Company is considering growing the warehouse capacity by renting additional space.

The goal of this capstone project is to develop recommendations on how to maximize profit for Interport's Miami warehouses using activity-based costing (ABC) of the services and more precise revenue allocation together with the customer segmentation.

The hypothesis of this project is that the Company can apply segmentation analysis to its customer base and services offering in order to focus on the most profitable cluster of customers and services to improve the overall profitability of the Company. The use of the segmentation analysis can also reveal the profitability drivers that the Company can leverage to turnaround the underperforming services and customers into source of healthy profits.

1.3 Methodology

The methodology for this project consists of four key steps:

1) data acquisition and cleansing;
2) revision of cost allocation model;
3) profitability analysis; and
4) identification of key parameters driving profitability.

For the application of activity-based costing we required transaction-level data, general ledger records on revenues and costs for the Company activities and organizational information, such as labor cost distribution among the Company divisions. The transactional data for this project was extracted from Magaya, Interport's Warehousing and Distribution ERP (Magaya Corporation, 2020), whereas the general ledger records were obtained from Quickbooks, Interport's accounting software. Additionally, the Company's human resources (HR) team provided the details of the payroll breakdown by departments.

Cleansed transactional and profit and loss data were used to propose an activity-based costing approach on the key overhead costs including labor, space rental and equipment depreciation, using underlying cost drivers. The existing income codes were reviewed to identify and allocate the portion of the income generated by warehousing and other services. The revised allocation of costs and revenues was then used to estimate profits per transaction and produce a segmentation analysis of services and customers.

1.4 Added value to the 3PL industry

With the global carrier companies driving down the margins for ocean freight, Interport needs to develop its value-added services into a major profit source. Such transformation can be achieved without extensive capital investments if the Company can focus on a combination of profitable customers and services and prune the low-margin customers that detract from the Company's constrained resources.

The problem with tracking profitability is not exclusive to Interport's Miami warehousing business, as according to the research by MIT's Jonathan L. S. Byrnes, "30 to 40 percent of each company's business – by any measure (accounts, products, transactions) – is unprofitable" (Byrnes, 2010). The findings and the methodology of this project can be extended beyond Interport's pilot project to other business units and territories. The end goal is to guide Interport and other 3PL companies toward more profitable operations as they grow their value-added Warehousing and Distribution operations.

2 LITERATURE REVIEW

2.1 Introduction

The objective of this capstone project is to study the profitability of Interport's services and customers and to design a roadmap that will improve the financial performance per type of transaction or cluster of customers. Before analyzing the profitability of a business unit, a commercial venture or an operations facility, it is important to establish a clear procedure of how to allocate resources and revenues to a customer or a service.

In the past, Interport used at least two models of cost allocation to estimate the profitability per client or type of service offered at the location. One model was based on activity cost drivers and the second on a predetermined distribution of the main direct and indirect costs. Neither of the proposed models has been well received due to inconsistencies in the results.

This literature review focuses on two major strands of research and modeling. The first strand reviews the existing cost allocation techniques to inform the decision on the most suitable way(s) to model the allocation of costs at Interport. The selected model was used in the project to estimate the profitability per client or service. The second strand investigates possible approaches to segmentation of customers and services. The segmentation implies creation of clusters by grouping customers or services based on their characteristics. The selected approach enabled cluster-specific recommendations on how to increase the total profit of the Company.

2.2 Cost Allocation

2.2.1 Traditional costing

Traditional cost (or volume-based) accounting systems were developed during the industrial era when labor-hours, machine-hours and raw material costs were the key volume-based drivers. In a traditional costing system, the indirect costs, such as rent and administration cost, were proportionately allocated based on these volume- drivers or the number of units sold. The

traditional costing system has been seen as distorting the true cost allocation for products consuming disproportionate amount of resources compared to the sales figures (Pohlen & La Londe, 1994).

2.2.2 **ABC and industry-specific variations**

In order to avoid inaccurate cost allocation resulting from traditional costing method an activity-based costing technique has been proposed. This accounting approach links the costs to activities and then to the customers, products or services that consume such activities. (Kaplan & Cooper, 1998; Themido et al., 2000). The steps involved in developing activity-based costing model are well summarized by Everaert et al. (2008), as set out in Table 1.

Griful-Miquela (2001) describes a methodology for implementing an ABC model for logistics. Further, an application of ABC with methodological and industry-specific adaptation for the logistics providers is proposed by Bokor & Markovitz-Somogyi (2015). While this research is helpful from the general approach perspective, a more detailed warehouse-specific application of the ABC model was sought. Such an application was addressed by Kucera (2019) that applied ABC allocation method in the calculation of the logistics costs for warehousing.

The findings of these articles could be used to review Interport's existing cost allocation models. The project considers whether further adjustments to the existing models are needed to create a baseline that is compared with the proposed cost allocation model developed by this project.

2.2.3 **Activity-based costing limitations**

The ABC models suffer from several deficiencies, as identified in Kaplan and Anderson (2004, 2007):

(a) Cost-driver rates are based on subjective opinions (of employees/managers).

(b) A single cost-driver rate per activity is not able to capture the factors that may impact the cost of that activity. Under an ABC model the only method to capture an impact of "special"

factors, is to create for each factor a separate activity with its own rules, thus increasing the complexity of the model.

(c) A large number of activities applied to customers/ products requires extensive resources to keep any model up-to-date as well as IT capacity to process the data.

(d) ABC wrongly assumes a 100% utilization of resources resulting in overstated cost-driver rates.

These limitations were taken into consideration in the cost allocation stage of our project. As discussed in paragraph 3.4.1 of the Methodology chapter, practical limitations of real life operations such as data quality and availability may limit the extent to which the deficiencies of ABC model can be fully resolved.

2.2.4 **Time-driven activity-based cost accounting**

Some of the deficiencies of the ABC model identified above can be addressed by using a time-driven activity-based costing (TDABC) model formulated in Kaplan and Anderson (2004, 2007). Under TDABC, instead of assigning resource costs to individual activities, companies estimate the resource demands by each customer/ service directly using two parameters:

- cost per time unit (e.g., $/hour) of supplying the resource (total cost divided by practical capacity [rather than theoretical 100%]); this is usually done at a department level; and
- the amount of time the resource is used by the customer/service.

Costs per customer/service are then derived by multiplying the cost per unit time by the unit time used. The strength of TDABC is its ability to easily adjust the cost per time unit depending on multiple factors that alter the cost – titled “time-drivers.” A summary of TDABC by Everaert et al. (2008) is set out in Table 1.

Table 1

Activity-based costing versus Time-driven activity-based costing

Activity-Based Costing
Step 1 – Identify the different overhead activities
Step 2 – Assign the overhead costs to the different activities using a resource driver
Step 3 – Identify the activity driver for each activity
Step 4 – Determine the activity driver rate by dividing the total activity costs by the practical volume of the activity driver
Step 5 – Multiply the activity driver rate by the activity driver consumption to trace costs to orders, products or customers
Time-Driven Activity-Based Costing
Step 1 – Identify the various resource groups (departments)
Step 2 – Estimate the total cost of each resource group
Step 3 – Estimate the practical capacity of each resource group (e.g., available working hours, excluding vacation, meeting and training hours)
Step 4 – Calculate the unit cost of each resource group by dividing the total cost of the resource group by the practical capacity
Step 5 – Determine the time estimation for each event, based upon the time equation for the activity and the characteristics of the event
Step 6 – Multiply the unit cost of each resource group by the time estimate for the event

Note. From Everaert, P., Bruggeman, W., Sarens, G., Anderson, S. r., & Levant, Y. (2008). Cost modeling in logistics using time-driven ABC: Experiences from a wholesaler. International Journal of *Physical Distribution & Logistics Management*, *38*(3), 172–191. https://doi.org/10.1108/09600030810866977

2.2.5 **Blended costing models**

While the advantages of TDABC over ABC are evident for complex operations which have multiple time-drivers (Everaert et al., 2008), this project considered whether a blended or hybrid ABC or a TDABC model is more suitable for the operations. In cases when some activities are basic or the available records are limited, for example for warehouse labor, and do not have cost altering variables, an ABC model may be sufficiently accurate.

The benefits of the hybridization approach, where adding one element of the ABC to the TDABC improves the accuracy of the model, are demonstrated in Wegmann (2019) and Hoozée and Hansen (2018). Another argument in favor of applying an ABC model to some warehousing operations is that TDABC's key parameter, work time, is not suitable for resources expressed in other parameters such as weight and area (Stonciuviene et al., 2020).

A typology of cost allocation models based on four perspectives is proposed by Wegmann (2019): external stakeholders, time, costing refinements and costing simplifications. The project considered a feasible approach of taking these into account when applying the ABC model. One of the problems of the allocation of costs in the logistics industry is the wide spectrum of customers: consumer, retailer, wholesaler and agents. The complexity of having multilayer counterparties is considered in this project when allocating direct and indirect costs.

Based on the results of the application of different cost allocation models, a comprehensive approach is proposed to estimate the costs per customer and per service. The costing model, together with the current revenue allocation, is used to develop a profit map that serves as a base case for the segmentation analysis.

The project adopts the recommendation by Byrnes (2010) that the accuracy of the cost allocation or profit calculation of every client or service does not need to be above 70% accuracy to create value in the analysis.

2.3 Customer and Services Segmentation

Using a profit map for customers/services clustered by profitability enables managers to identify the key profit levers and deploy them to improve company's profitability (Byrnes 2012). This profit mapping involves 5 steps:

(1) constructing a profitability database,

(2) modeling a representative customer,

(3) projecting findings from model customer to the corresponding cluster of customers,

(4) applying quick, high-impact changes to improve profitability, and

(5) repeating the exercise every 6 months while applying account qualification criteria (Byrnes, 2010).

While the natural inclination may be toward pruning any unprofitable customers or services, the project considered at what stage customer/service rejection is appropriate, including whether such services are a part of broader strategy. Ringelstein (2018) also warns against continuous customer pruning, in his critical review of time-driven activity-based cost accounting:

> In deed [sic] a problem inherent in activity-based costing that has been overlooked is the fact that when a product or service is identified as being unprofitable eliminating it results in a redistribution of costs to those remaining and subsequently reducing their profitability. This potential for creating a spiralling effect should act as a warning for cautionary decision making by management. (pp. 25-26)

The risk of continuous pruning of customers is addressed in Byrnes (2010), which states that the main purpose of segmentation analysis is not to eliminate customers or services that are unprofitable, but to study how to make them, or some of them, profitable, by renegotiating the pricing structure. This approach is in line with the proposal of this project, which is not limited to

identification of profitable customers and services but extends to recommend actions on improving the profitability of the existing operations.

A very interesting finding was described by Järvinen and Väätäjä (2018, p.32) when posing the research question: "*How do companies with different customer relationships make use of time-driven activity-based costing in their customer profitability analyses*?" In one of their results, they stated that if a system like TDABC is implemented, it is unlikely that the profitability of the business will improve. However, the firm will acquire knowledge of the cost drivers and their relationship to the profits. This knowledge will improve the state of the business model and grow the profit base.

The benefit of using more than just one method for the evaluation of the customer value in logistics companies is highlighted in Januszewski (2011). In addition to the current profitability of a customer, alternative methods such as customer lifetime value method (CLV), recency, frequency, monetary (RFM) and past customer value (PCV) methods suggest considering present value of future cash flows from the customers as well as discounting past purchasing behavior of a customer (Januszewski, 2011). Although such methods can help provide a broader understanding of the strategy for a customer, the scope of this project focuses on more short-term recommendations based on the current customer/service profitability.

2.4 Conclusion

The project identified earlier research on the activity-based costing and other cost allocation models in the logistics sector and marketing research on customer segmentation. The literature review identified that a blended TDABC and ABC are likely to be the most suitable costing models for this project. The review on studies of customer/service segmentation offered some complex methods, which may not be suitable for the limited scope of this project. In addition to the customer/service cluster segmentation methods, the review covered the activities appropriate to improve the profitability for the Company which were adopted by the project.

There appears to be limited research on allocation of costs for the warehousing activities and no known attempts in the published literature to link the Warehousing and Distribution customer or service segmentation to profitability analysis based on a version of an activity-based costing model. This project seeks to fill this gap.

This project focuses on the application of the costing model in profitability analysis of Interport's warehousing operations in Miami only. However, when the Company decides to scale the proposed model to its other business divisions it should consider the complexities of allocating costs at a group level.

3 DATA AND METHODOLOGY

Interport Logistics USA (Interport) is seeking a cost and revenue allocation model that would show true profitability of a customer or service to enable it to develop an effective strategy for growth.

In this chapter we describe the background and the general approach to methodology, the definition of activities for the ABC analysis, the service type categorization and the choice of cost drivers reflecting the main service types. We then provide an overview of the methods used for the profitability mapping in the Results and Discussion chapter based on the revenue and cost allocation model developed for this project.

3.1 Background and scope

3.1.1 Limitations of Interport's previous models

As Interport evolved from a freight forwarding company into a third-party logistics (3PL) service provider, its KPIs and the P&L accounting were not adjusted to accurately represent the cost and income from other business units such as Warehousing and Distribution. Therefore, the Company cannot accurately identify the services and customers that currently generate the highest profits and what kind of offerings should be developed to further increase the returns. Since 2015, Interport has tried twice to design a model to correctly allocate income and expenses at a customer level.

The first model estimated the storage and handling cost per cubic foot and allocated it among major customers based on their shipment volumes. This model was very generic and suffered from the problem described in the cost accounting literature as "underestimating the consumption of resources by low-volume operations/customers" (Kaplan, 2001).

The second model distributed labor and space costs using cost drivers such as warehouse receipts, volume in and out, and the total volume handled. In some cases, the management made informed guesses on the appropriate ratios for cost allocation. Both models indicated that only

the ocean freight business is profitable and that some of the major client accounts are loss-making. This observation was not credible, leading Interport to conclude that the models are still inaccurate in cost allocation, and to wrongly attribute income earned by the warehouse operation to the freight forwarding business. An improved model for assessing service and client profitability is required.

3.1.2 **Scope**

The objective of this project is to develop a total cost and revenue model for Interport's Miami warehouses by identifying the true profitability of the current customers and services. For methodology we generally followed the Cross-Industry Standard Process for Data Mining (CRISP-DM) (see Figure 1).

Figure 1

Cross-Industry Standard Process for Data Mining (CRISP-DM)

Note. From Cross-industry standard process for data mining. (2020). *Wikipedia*. *https://en.wikipedia.org/w/index.php?title=Cross-industry_standard_process_for_data_mining&oldid=988849221*

Using CRISP-DM as a reference, we have identified the following four core sets of activities to achieve the project goal:

(i) gathering, understanding, and cleaning the data (the Business Understanding, Data Understanding and Data Preparation steps within CRISP-DM);

(ii) estimating more accurately the profitability of current services and clients by using activity-based costing models and allocating revenue to the correct activities;

(iii) segmenting Interport's clients and services into clusters based on their profitability profiles, using statistical methods for the initial segmentation and followed by a more in-depth analysis to understand patterns and reasons (this activity together with activity (ii) constitute the Modeling and Evaluation steps within CRISP-DM); and

(iv) developing recommendations for improving the profitability by customer and service clusters (the Deployment step within CRISP-DM).

3.2 Collecting, understanding and cleaning the data at a shipment level

To develop a good understanding of the business, we arranged a series of interviews with Interport executive management. Following the interviews, we obtained data extracts from Interport's Warehousing and Distribution ERP system, Magaya, and profit and loss statements by activity types. Further meetings with Interport's operations managers were conducted to understand the data structure and flow, as well as the level of details stored in the datasets. To assist with this task, we first created a data dictionary, which explained the meaning of the headings of columns of the Magaya datasets. Using a 3-month sample of transactional data, we developed an understanding of the underlying data structure and the entity relationships between warehouse receipts, transactional item records and shipment records as well as the associated costs (services billed to Interport) and revenue (invoices sent to the customers). After mapping

out the relationships between the datasets we obtained a full-year dataset for 2019, chosen as a recent period that would not be distorted by the unusual service requirements and customer activity during the COVID-19 pandemic in 2020.

3.3 Approach to P&L analysis

The transactional dataset and the annual profit and loss data at an activity level (as categorized in the general ledger) was processed using analytics software called the Profit Isle Solution. The Profit Isle Solution makes possible the assignment of profit and loss to each transaction line (**transaction** or **line**) in order to generate a high-level P&L data by key vectors, such as a company's operations, service types and customers (Profit Isle, Inc, 2021). The software relies on user-defined data relationship structure and rules for allocating revenue and costs. At this stage we conducted multiple iterations to define appropriate activities and cost drivers to be used in the software for activity-based costing and P&L analysis.

3.4 Application of activity-based costing

To define the rules for allocating costs we first had to select a cost allocation model that could be applied to our dataset. The nature of the data structure also required for a model for the allocation of the aggregated direct costs. After addressing the direct costs, we identified that the activity categories as defined in the Company's general ledger, were most suitable cost centers for the activity-based costing of the overheads. Such approach to overhead cost allocation naturally led to the use of the same activities for the revenue allocation in order to derive the P&L profile of the transactions. When defining our cost allocation model we also reviewed the most appropriate categorization of the Company's services by types and how the service types impact the model definition.

3.4.1 **Selection of cost allocation model**

Based on the cost allocation techniques identified during the literature review, we originally planned to allocate labor and administrative costs using a time-driven activity based costing (TDABC) model, due to its advantage of accounting for practical, instead of nominal, capacity of resources. For activities where we would not find detailed time utilization by transaction types we were going to use the ABC method.

When considering the application of TDABC model we concluded that the project dataset did not contain sufficient and accurate enough data to derive the time estimates of the activities. The time estimates for activities could be obtained through study of the actual activities and the interviews on site, however such avenues were not possible during this project when COVID-19 pandemic-related travel restrictions, quarantine requirements and work-from-home policies limited the ability to generate data from observations.

The limitation inherent in the ABC method of increasing model complexity when trying to account for 'special' factors impacting the cost was resolved by using the Profit Isle software. As demonstrated in the paragraph 3.5 and Table 4, the software allows users to apply multilayer activity drivers as well as filters to the transaction types that require complex allocation of the costs. In addition, use of objective cost drivers (such as volume, revenue and # of transactions) applied to general ledger-defined activates has reduced the amount of subjective input into the ABC model.

The structure of the transactional dataset also presented challenges in the application of activity-based costing to overhead costs, as well as in the traditional cost allocation approach to direct costs (cost of goods/services sold or COGS).

3.4.2 **The data structure and the revised direct cost allocation model**

The data analysis revealed that Interport's business model does not allow a direct link between the variable costs, or pass-through costs, and the invoices sent to customers. The reason for this complexity stems from the relationship between the cost codes and income codes used in the ERP system.

The Company generates revenue from invoicing its customers based on the cubic volume or the volume-weight of their shipments. Customers' shipments are linked to individual bills of lading (contracts of carriage between forwarder and a customer), referred to as House shipments (**Houses**). The smaller shipments, are consolidated by Interport before a Master bill of lading that is then provided to the ocean or air carrier. For example, in case of ocean freight, Master level refers to the bill of lading for a container that contains several shipments (Houses) belonging to, and paid for, by different customers. Interport is charged by the carrier at the Master bill of lading level (e.g. a flat fee per container). Consequently, the revenues are linked to the Houses, whereas the direct costs (carrier cost, fuel surcharges and customs processing fees) are incurred at a Master level.

The Master shipment as well as its constituent Houses are assigned the same Master Waybill Number, and together comprise a Master Waybill cluster for tracking and identification purpose. Customer shipments that are sufficiently large and are passed to the carrier at without consolidation and creation of dual Master-House level entries, instead, Interport categorizes such transactions as "Direct".

Our initial expectation was that costs at Master level could be assigned based on volume or volume-weight metric of each House shipment. However, we found that Interport had many-to-many entity relationship between the activity codes used for invoicing and the activity codes used for recording the costs of services billed to Interport. As a result, the general ledger records used for invoicing the customers did not reflect the categories of direct cost incurred by Interport,

preventing direct traceability of the invoice to the cost of providing the service (COGS). An example of such cost-to-invoice mismatch for an airfreight shipment is presented in Table 2.

Table 2

Sample table showing cost-to-invoice disparity in invoice and cost codes

Shipment Level	Invoice code description	Invoice amount ($)	Cost code description	Cost ($)
House	Freight Forwarding	85		0
House	LCL Local Delivery Fee	55		0
House	Air Freight	185		0
Master	Agent Profit Share	-50		0
Master		0	Cartage and/or Drayage	30
Master		0	Air Freight	55
Master		0	Fuel Surcharge Fee (Air)	15
Master		0	Security Surcharge Fee	10

From Table 2 it can be seen that at Master level the Company incurred Cartage and/or Drayage cost, Fuel Surcharge Fee, and Security Surcharge Fee, however, these items are not reflected in the invoice code descriptions used to invoice the customer. Moreover, the invoice to the customer reflects invoice items Freight Forwarding and LCL Local Delivery Fee, which are not linked to the direct cost.

The consequence of this cost-to-invoice disparity is that even the direct costs are morphed into indirect costs that require activity-based cost allocation. For cost allocation within each Master Waybill cluster we used the following sequential cost distribution approach:

i) Firstly, we allocated all costs incurred at the Master shipment level to the House transactions with the same Master Waybill number.

ii) Secondly, we assigned the Master costs proportionately between customers using the respective cubic volume of cargo indicated in the invoices issued to customers.

iii) Finally, we distributed the cost to the activities listed in the Customer invoice by proportion of revenue. As a result of this allocation we were able to match $14m cost of services (COGS) to the corresponding transactions.

One of the benefits of this approach are that the costs are linked to the paying customer and are not affected by the complexity of multiple counterparties “touching” the shipment such as shippers, consignees, intermediate consignees, carriers and agents

3.4.3 Definition of activities for activity-based costing of overhead expenses

In the traditional activity-based costing approach the activities are usually linked i) at a high level, to the department, or ii) at the more granular level, to the underlying operations (often physical activities), and then the related costs are assigned to customers based on their usage of such activities. The first option was not adopted for our analysis as the Company has few departments and the resulting cost allocation would be too broad. The second option was not possible due to the lack of information about the warehouse physical activities and the resources utilized by them. Therefore, for our project we adopted an alternative approach to the definition of activities. For activity-based costing we used activity types used in the general ledger, as these gave direct and most accurate linkage to the costs and revenues, and were the closest level of activity to the actual distinct physical tasks.

3.4.4 Revenue allocation

By using the activity types from the general ledger, we adopted the existing revenue allocation to the activity types based on the revenue codes referenced in the invoices. While a more prescriptive approach to invoicing policy is discussed in Chapter 5 (Conclusions and Recommendations) of this project, the factual approach is appropriate for analysis of the current profitability of the Company.

3.4.5 **Definition of service types to inform selection of cost drivers**

Before we could identify the appropriate cost drivers we had to take into account the services to which the activity drivers would be assigned. During the interview process, Interport's management team suggested labeling existing services based on the management's categorization of general ledger codes. The management's current definition of service types falls into one of the following four categories:

(i) Direct Shipments, covering the services which did not involve the Warehousing and Distribution activities;

(ii) Pallet-in pallet-out;

(iii) Pick and pack; and

(iv) E-commerce.

We used these company-defined service labels for one of the iterations of the P&L analysis. We also found that the attributes of the transactional dataset itself could be used to differentiate the services types (**transaction-derived service labels**). In particular, we tried to link the warehouse receipts records to the cost (bills) and revenue (invoices) codes. Due to the fractional data structure, the general ledger codes could only be linked to the outbound shipments from the warehouse, and then the outbound shipments would be linked to the corresponding warehouse receipts. This method had its own limitations:

(a) The first limitation was that in addition to the outbound shipment transactions, the items can leave the warehouse through a special type of transaction called Cargo Releases. However, the integration of the Cargo Release database into the invoice/bill-shipment-warehouse receipt model would require a substantial increase in complexity in return for capturing only 0.56% and 0.12% of additional revenue and cost, respectively. For this reason, the Cargo Release category was disregarded and the respective revenue and costs would be allocated proportionately to the outbound shipments.

(b) The second limitation related to the process inconsistency for recording the part numbers of the shipped cargo. A part number entry can be made only at the stage of pick and pack and e-commerce activities. Therefore, in theory, all line items containing part number entries in the database should relate only to these services, to the exclusion of the Direct Shipment services, and pallet-in pallet-out services in the warehouse.

(c) When we applied service type filters (based on company-defined labels as well as the transaction-derived labels) to the dataset, the part number entries did not match the expected result in either case. This anomaly calls for the revision of the current understanding of the process for recording part numbers, which was beyond the scope of this project and, therefore, disregarded for the purpose of cost allocation and further analysis.

Use of outbound shipments as the linking feature was sufficient to establish in an objective way what portion of revenue and costs were linked to the warehousing activities.

We then compared the results of P&L analysis from using the objective approach to labeling of the transactions as Direct Shipments or warehousing services (based on the warehouse receipt entries) to the results from using Company's internal Direct Shipment label applied to the general ledger codes.

3.4.6 **Selection of data-driven service types over company-defined service labels**

After we applied the overhead allocation rules (described in paragraph 3.5), the company-defined Direct Shipment services appeared to be responsible for 83% of revenue, 69% of gross profit and 311% of net profit. The net profit percentage in excess of 100% meant that the profits from the company-defined Direct Shipment were subsidizing other types of loss-making services.

When company-defined Direct Shipment service was assessed against the warehouse receipts it transpired that, in violation of the logic of the rule, 71% of Direct Shipment transactions by

revenue or 76% by lines “visited” the warehouse. The same level of inconsistency was observed in respect of the other three types of services (pallet-in pallet-out, pick and pack, and e-commerce), which by their nature require warehousing activities but did not have corresponding warehouse receipts. Given the extent of inconsistency, we chose to base our analysis on the transaction-derived service labels based on the presence or absence of a matching warehouse receipt in the dataset.

As discussed in Chapter 4 (Results and Discussion), when using the objective service type labeling, our data analysis revealed that only 35% of transactions by revenue were Direct Shipment but these accounted for 62% of annual profits. The comparison between Direct Shipments and warehouse transactions are set out in the Table 3.

Table 3

Comparison of Profit and Loss metrics of Direct Shipment and warehousing services

Transaction type based on Warehouse receipts	Total Revenue % split	Gross Profit % split	Profit % split	Profit margin	Number of transactions	Lines % split
Direct shipment	35%	18%	62%	6.3%	15,112	24%
Warehousing	65%	82%	38%	2.0%	46,873	76%

3.5 Cost allocation approach

The selection of the mutually exclusive service types linked to the warehouse receipts allowed us to limit the assignment of the warehousing-related costs (rent, warehouse labor and administration, as well as equipment depreciation) only to warehousing services. In contrast, the cost to sell (marketing costs), office labor, and general and administration costs were recognized as applicable to all types of transactions and were assigned in accordance with general rules of allocations we defined in our model.

Before the actual activity drivers were applied, we assigned the major overhead costs to the relevant cost centers. The total labor cost was first split by department based on data provided by Interport's human resource department. For example, payroll cost was distributed among different cost centers such as the warehousing activities, sales, HR, central office administration and management. In addition, for consulting and professional fees, depreciation and rent we sought Company management's guidance on the allocation among P&L categories. The impact of the department and P&L level allocation of costs was that the same overhead costs would be split into portions, with one portion assigned to all transactions and another portion only to warehousing transactions, thus decreasing the warehousing services profitability compared to the Direct Shipments.

Once the high-level allocation of overhead costs among the cost centers was completed we identified the following activity drivers to be applied to the cost centers. The allocation of the costs to the drivers was done on a month-by-month basis in order to preserve the time-series details of the model. Some P&L items required application of multiple layers of filters and activity drivers. The numbering in Table 4 below reflects the sequence of applying the drivers (1 being the first in order of application).

Table 4

Filters and activity drivers applied to key P&L items for activity-based costing

	# Warehouse Receipts in Master Waybill	Cubic Volume in the Invoice	# activities in the Invoice	Revenue in the Invoice	Other
Revenue					
Gross Revenue				Direct link	
Agent Profit Share				2	1 – Master Waybill by the Profit Share amount
Other Revenue				1	
Cost of Sales					
COGS		2		3	1 - Costs charged to the Master Waybill
Other COS				1	
Cost to Sell					
Sales Labor, Clearance Brokerage, Marketing Costs			1		
Professional and Consulting Fees (Selling)				2	1 – number of invoices
Cost to Serve					
Distribution Labor	1	2	3		
Distribution Office Labor	1		2		
Warehouse Labor, Occupancy and Depreciation	1	2	3		
Caribbean Customer Service			1		Filter: Ocean Freight Mode for Caribbean
Latin America Customer Service			1		Filter: Ocean Freight Mode for Latin America
Air Customer Service			1		Filter: Air Freight
Vehicle and Equipment	1	2	3		
Professional Fees			1	2	
G&A					
Management, HR, Bonus pay				1	
Administrative and IT			2		1 – number of invoices
Bad Debt			2		
Legal & Consulting Fees				2	
Corporate Occupancy and Depreciation			2		

The application of the multilevel allocation rules is described below using a hypothetical example:

(a) For allocation of the total Distribution Labor Cost (part of Cost to Serve) for 2019, the monthly Distribution Labor cost is allocated to the shipments in the corresponding month (e.g. $40,000 in March 2019).

(b) Then the monthly Distribution Labor Cost is allocated proportionately to all shipments with the same Master Waybill code in that month based on the number of warehouse receipts. A Master shipment that generated 4 of 10 warehouse receipts in that month gets an allocation of $16,000. Shipments with zero warehouse receipts would not receive any allocation as no warehousing operations were utilized.

(c) The portion of the cost allocated to the Master shipment is distributed among the invoices issued to the customers (houses) based on the volume of cargo indicated in those invoices (e.g. invoice to a customer for a 1,000 cubic ft. cargo out of a total of 2,000 cubic ft. Master shipment gets assigned $8,000 portion of Distribution Labor cost).

(d) As the last step, the fraction of the Distribution Labor Cost assigned to an invoice is then applied to the individual activities within the invoice based on the count of such activities in that invoice. Thus in an invoice with four activities (e.g. Air Freight, Drayage, Inland Freight, and Handling) each activity gets assigned $2,000 of the Distribution Labor Cost.

The revenue and cost allocation model described above led to a new profitability profile for the general ledger level activities, the major service types and the customers.

3.6 Profitability Model and Recommendations

Once costs were traced to the general ledger-level activities with sufficient accuracy, we applied statistical analysis to segment the customers and the services and map their profitability profiles.

The first, and one of the most informative, types of profitability mapping performed using the Profit Isle Solution was to map the customers and services using a two-by-two matrix for revenue and profit.

The revenue was set on the x-axis and profits on the y-axis. The customer or service was then analyzed for its contribution to the total company revenue and profit, with the top 80% of contributors being put in the top quadrant. The findings from this analysis are discussed in detail in paragraph 4.2.

Further analysis of the services and customers was performed by comparing Gross profits to net profit. Such comparison provided valuable insights on the allocation of the indirect costs and the main factors affecting customer/service net profitability.

Additional features, such as the freight mode and number of transactions, were considered for any further insights or any clear patterns that are prevalent in high performing or underperforming customer.

The exercise generated insights into which parameters drive the Company's profits and which entities (customers or services) draw on Company's resources without delivering adequate returns.

In conclusion, the project makes recommendations to Interport as well as other industry participants on the methodology improvements as well as use of profit levers identified through the profit mapping to improve the Company's net profit margins. The recommendations also consider appropriate actions for dealing with unprofitable or break-even customers. Finally, areas for improvement of future research were identified.

4 RESULTS AND DISCUSSION

This chapter presents the results of the profit mapping and segmentation analyses. Using P&L statements per transaction, a profit map is created from different perspectives: customer size or activity, services and types of operations, or modes of transportation. Because we have the P&L for each transaction, they can be aggregated to create a broader view like a Pareto's 80/20 rule of segmenting between the significant few and the trivial many, or a more granular view where clusters are created either by revenue or profit.

We start with a general 2x2 matrix to represent a Pareto type of segmentation by quadrants, then we conduct a more detailed view by quartiles of those quadrants and then a granular view by histograms by revenue or profits. The main purpose of this approach is to create clusters where similar characteristics arise or similar strategies to maximize profits, can be designed and implemented. Further analyses are made from different perspectives, like freight mode, customer frequency or a combination of many features. We demonstrate that the main reason behind profitability is the allocation of the Cost to Serve in Warehousing and Distribution activities.

4.1 Profit mapping

The main objective of this project is to identify which clients or services are profitable, which are not and why. To achieve that, we created a database using Profit Isle Solution (a specialized software), where the transactional data from the Company's ERP system was matched with the financial and accounting data from the general ledger of the Company. Then, the software was used to create profit and loss statements (P&L) for each transaction, allocating the various cost streams according to different methodologies.

Multiple segmentation analysis is done via profit mapping by features (such as, by customer, by mode of transportation, and by type of service). We explored the most important ones to study the profitability of each cluster or segment, and the impact of that feature on the business. Also,

we compared results with preconceived beliefs that the Company had regarding profitability of operations like the freight mode.

Another useful capacity of this software is to create various cost clusters to allocate resources like labor or rent. Cost to Serve and Cost to Sell are a different way to view and distribute the expenses of the Company. These cost clusters and their contribution to the profits can be compared when different customers or services are analyzed.

A general Profit and Loss statement of the Company is generated by aggregating each of the 61,985 transactions' P&L (see Table 5). Additionally, dividing each component of the general P&L by the total number of transactions, creates an average cost or revenue per line ($/line) that is useful to compare with prices or expenses.

Table 5

Aggregate Profit and Loss Statement based on new cost allocation model
Total number of Lines or Transactions: 61,985

Profit Isle P&L	US$	% of Revenue	$/line
Revenues	25,607,360	100.0%	413
Cost of Sales	15,326,297	59.9%	247
Gross Profit	10,281,064	40.1%	166
Cost to Sell	1,125,689	4.4%	18
Cost to Serve	6,116,563	23.9%	99
Contribution	3,038,812	11.9%	49
G&A	2,135,141	8.3%	34
Profit	903,670	3.5%	15

- Cost of Goods Sold or Cost of Sales are the Direct Cost associated with the commercial transaction like freight, customs, demurrage, and other similar expenses.
- Cost to Sell includes marketing expenses, salesforce salary and sales commissions.
- Cost to Serve includes warehouse rent, warehouse personnel, customer service, etc.
- G&A includes overhead costs like IT, human resources and accounting departments, management costs, consulting fees and other expenses.

Table 5 shows that the Gross Profit (Revenues minus Cost of Sales) is 40% of the revenue and on average, each transaction has a gross profit of $166. Contribution is the result of subtracting the Cost to Sell and the Cost to Serve from the Gross Profit. In this case, the average contribution is 12% of the revenue or $49 per transaction. When overhead costs (G&A) are deducted from the Contribution, the result is a profit of 3.5% of the revenue or the equivalent as an average of $15 per transaction.

Table 6 is a comparison of the P&L generated with Profit Isle software and the Company's P&L. The column of $/line is added to show the magnitude of the different cost functions or resources compared to the revenue and profits.

Table 6

Comparison of the P&L generated by Profit Isle software and the Company's P&L

Profit Isle P&L	% of Revenue	$/line
Revenues	100.0%	413
Cost of Sales	59.9%	247
Gross Profit	40.1%	166
Cost to Sell	4.4%	18
Cost to Serve	23.9%	99
G&A	8.3%	34
Total Cost	36.6%	151
Profit	3.5%	15

Company P&L	% of Revenue	$/line
Revenues	100.0%	410
Cost of Sales	60.7%	249
Gross Profit	39.3%	161
Labor	17.5%	72
Rent	9.0%	37
Other Expenses	9.2%	38
Total Cost	35.7%	146
Profit	3.6%	15

There are differences in the $ per line in comparable items like Revenues or Cost of Sales because the match is not perfect between aggregating P&L per line and the P&L of the Company created from the accounting software. However, the differences are very small and do not need to be adjusted or reviewed. The importance of this comparison is that confirms that an aggregated P&L can be calculated from transactional data derived from the ERP and the general ledger. From Table 6, there are some results that are important to highlight, when expressed as average cost per line or transactions: the total cost of the operation is approximately $150 and the average profit is only $15 per transaction.

4.2 Profit mapping of Customer

Before analyzing the performance at a customer level, we obtained Interport's guidance on which customers belonged to the same parent company. This allowed for a P&L analysis at a group level (**Parent Customer**). Analyzing the data for the year 2019, we establish 475 different Parent Customers from a total of 619 customers. We started the profitability analysis of Parent Customers by conducting a descriptive statistical analysis of the main financial components (see Table 7).

Table 7

Descriptive statistics of the financial components of the Company P&L viewed at Parent Customers perspective for 475 firms

		Sum	Min	20th	Median	Mean	80th	Max
Revenue	**US$**	25,607,360	(11,567)	423	2,827	53,910	16,273	9,168,337
Gross Profit	**US$**	10,281,064	(515,968)	138	863	21,644	5,136	5,029,171
Gross Margin	**%**	40		33	31		32	
Profit	**US$**	903,670	(594,102)	(943)	(16)	1,902	1,091	2,591,884
Net Profit	**%**	4		(63)	(1)		26	
Lines	**#**	61,985	1	3	9	130	61	13,963
$/Line	**US#**	413	(198)	86	197	479	582	14,659

From the data we can highlight some interesting characteristics:

- it is a very dispersed population;
- there are customers with large and small transaction volumes;
- there are customers with very high profits or substantial losses;
- some of the customers are very active, but others are infrequent in the number of transactions per year;
- There are customers that generate losses (also referred to in this project as **negative profits**); and
- some customers have negative *revenues*.

The rationale for existence of negative revenues is that the general ledger reflects the adjustments to include rebates to customers (discounts) or agent profit sharing arrangements (processed as

credit memos) that occur in the previous or the following accounting period. Customers with a negative revenue is a special and infrequent event (2.74% of total customers and 0.08% of the total revenue). Because of the small occurrence, we can safely use the proposed profit-mapping.

However, customers with negative profits or losses are customers with positive revenues and positive gross profits, but when operating and overhead costs are allocated (IT, labor, rent, maintenance) using the cost-allocation methods, the profitability of the customers becomes negative. In this chapter we use terms “loss” and “negative-profit” interchangeably.

We use the following naming convention for the tables and graphs in this chapter:

HH: High-Revenue and High-Profit

HL: High-Revenue and Low-Profit

LH: Low-Revenue and High-Profit

LL: Low-Revenue and Low-Profit

A profitability map in the form of a 2x2 matrix reflecting revenue and profits levels is created from the P&L per transaction dataset (see Figure 2). Using the Pareto principle for segmentation, the right-hand quadrants (HH and HL) will contain Parent Customers that generate the top 80% of the total company’s revenue, with the Parent Customers responsible for the remaining 20% of revenue appearing in the left quadrants (LH and LL). Then, the top quadrants in each side of the matrix reflect the Parent Customers responsible for the top 80% of the positive profits, with the lower quadrants capturing the rest of Parent Customers with positive profits plus the Parent Customers with negative profits.

Figure 2

Parent Customers profitability map based on revenue and profits levels

PROFITS	Low-Revenue	High-Revenue
High-Profit	**LH**	**HH**
		1% of P-Customers (4) 24% of Lines 45% of Revenue 66% of Gross Profit (59%) 28% of Cost to Serve (15%) 460% of Profits (36%)
Low-Profit	**LL**	HL
	95% of P-Customers (451) 38% of Lines 20% of Revenue 15% of Gross Profit (29%) 36% of Cost to Serve (42%) -200% of Profits (-35%)	4% of P-Customers (20) 37% of Lines 34% of Revenue 19% of Gross Profit (23%) 36% of Cost to Serve (25%) -160% of Profits (-16%)

REVENUES

The figure in parenthesis next to the P-Customer entries represents the number of customers in that quadrant. The percentages in parenthesis next to other entries represent the proportion of that P&L level entry against revenue e.g. in LL 'Gross Profit (29%)' means a 29% gross profit margin for the revenue attributed to that quadrant only.

To describe and understand Figure 2, we use quadrants HH and LL:

- In HH, 1% of the total 475 Parent Customers (4) are responsible for 24% of the transactions, generating 45% of the revenue and 66% of the gross profit of the Company
- In LL, 95% of the 475 Parent Customers (451) are responsible for 38% of the transactions, generating 20% of the revenue and only 15% of the gross profit
- The average gross profit of customers in HH is 59% of the revenue. For customers in quadrant LL, the average is 29% of the revenue.

However, 460% of the total company profits are generated by the 4 customers in the HH quadrant while -200% of the total company profits (mainly losses) are produced by the 451 customers of the quadrant LL.

More detailed information for each quadrant is obtained by dividing each one into quartiles of the number of Parent Customers (i.e., Quadrant LL has 451 Parent Customers and is divided in three quartiles of 113, and a fourth of 112 Parent Customers, arranged in descending order by the amount of profits). For each quartile, the aggregated financial components and the number of transactions are presented in Table 8.

Table 8

Financial Components per Quadrant and Quartiles, by customers

Quadrant	P_Customer	Revenue	Gross Profit	Profit	Lines
HH	4	11,604,792	6,784,537	4,161,332	15,106
HL	20	8,800,719	1,991,136	(1,450,176)	23,037
LL	451	5,201,849	1,505,390	(1,807,486)	23,842
Quartile	**P_Customer**	**Revenue**	**Gross Profit**	**Profit**	**Lines**
HH_1	1	9,168,337	5,029,171	2,591,884	13,963
HH_2	1	1,306,802	927,448	822,332	751
HH_3	1	837,120	586,769	526,429	284
HH_4	1	292,533	241,150	220,687	108
HL_1	5	1,567,850	703,167	432,682	3,513
HL_2	5	933,843	233,020	36,507	1,035
HL_3	5	1,509,510	388,573	(187,563)	5,596
HL_4	5	4,789,516	666,376	(1,731,802)	12,893
LL_1	113	2,570,840	1,271,692	720,608	5,947
LL_2	113	424,572	110,545	26,484	1,133
LL_3	113	289,566	57,999	(19,104)	921
LL_4	112	1,916,872	65,154	(2,535,474)	15,841

Using the information generated in Table 8 and ordering all quartiles by the amount of profits, we can create a different view (see Table 9). Additionally, two subsets are created containing all the quartiles with positive or negative profits to make possible a comparison.

Table 9

Financial Components of Parent Customers' Quartiles, sorted by Profits

Quartile	P_Customer	Revenue	Gross Profit	Profit	Lines
HH_1	1	9,168,337	5,029,171	2,591,884	13,963
HH_2	1	1,306,802	927,448	822,332	751
LL_1	113	2,570,840	1,271,692	720,608	5,947
HH_3	1	837,120	586,769	526,429	284
HL_1	5	1,567,850	703,167	432,682	3,513
HH_4	1	292,533	241,150	220,687	108
HL_2	5	933,843	233,020	36,507	1,035
LL_2	113	424,572	110,545	26,484	1,133
LL_3	113	289,566	57,999	(19,104)	921
HL_3	5	1,509,510	388,573	(187,563)	5,596
HL_4	5	4,789,516	666,376	(1,731,802)	12,893
LL_4	112	1,916,872	65,154	(2,535,474)	15,841

All Profits	240	17,101,897	9,102,962	5,377,613	26,734
All Losses	235	8,505,463	1,178,102	(4,473,943)	35,251
Total	475	25,607,360	10,281,064	903,670	61,985

All Profits	51%	67%	89%	595%	43%
All Losses	49%	33%	11%	-495%	57%

In Table 9, the first 8 quartiles have positive profits. The remaining four quartiles are the ones with negative profits. "All Profits" subset refers to the aggregation of all positive profits quartiles and has 240 profitable Parent Customers. This subset represents 51% of the Parent Customers and is responsible for generating 43% of the transactions, 67% of the total revenue, and 89% of the total gross profits. Additionally, if we compare this subset with the total profit of the company, which is the sum of profitable and unprofitable customers (here, quartiles with positive and negative profits), the profitable quartiles, taken alone, are six times greater than the total profit of the company. (See Table 9: All Profits vs. Total). It is important to highlight that there are 2 quartiles that are not from the HH quadrant in the top 5, from the profit's perspective. (in Table 9, LL_1 and HL_1) This is because in quadrants LL and HL, there are customers with positive and

negative profits. Once quartiles are created, the top layer or first quartile has the customers with the positive or better profits than the bottom quartile customers.

Because LL_1 contain 113 customers, a more detailed analysis must be made to characterize if there are features or reasons to separate them into smaller clusters in order to use different strategies to improve their performance or contribution to the business.

The same information from Table 9 is represented in the form of cumulative profits in Table 10. A curve showing how much each quartile contributes to the Company total profit is shown in Figure 3.

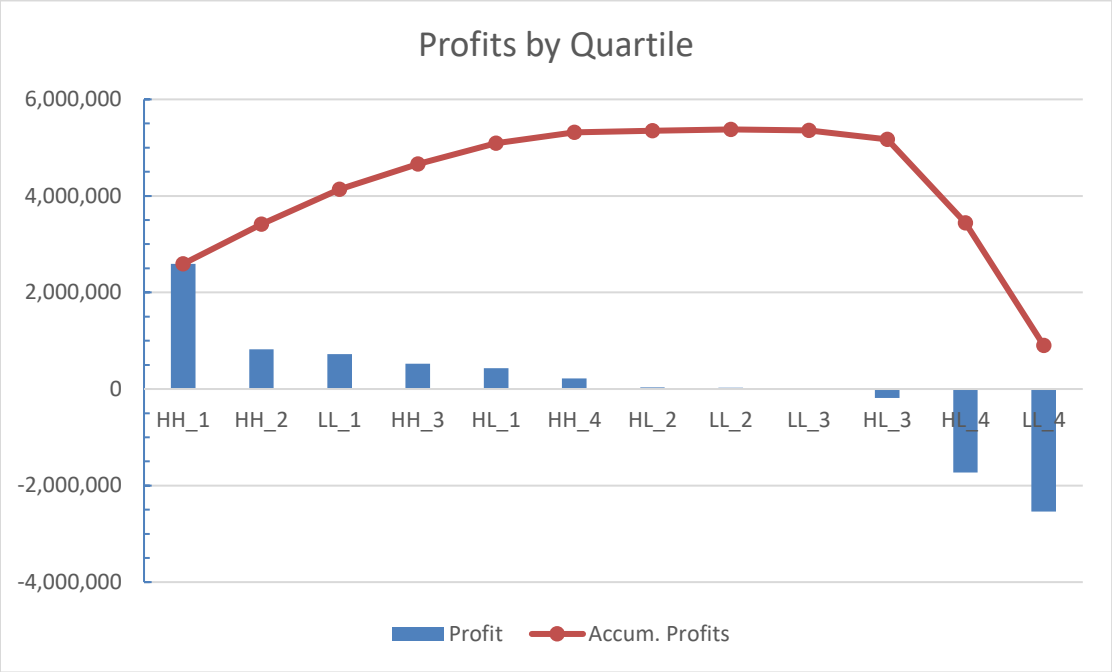
Table 10

Profit and Cumulative Profits by Quartile, sorted by Profits

Quartile	Profit	Accum Profit
HH_1	2,591,884	2,591,884
HH_2	822,332	3,414,216
LL_1	720,608	4,134,824
HH_3	526,429	4,661,253
HL_1	432,682	5,093,935
HH_4	220,687	5,314,622
HL_2	36,507	5,351,129
LL_2	26,484	5,377,613
LL_3	(19,104)	5,358,509
HL_3	(187,563)	5,170,946
HL_4	(1,731,802)	3,439,144
LL_4	(2,535,474)	903,670

Figure 3

Profits and Cumulative Profits of Parent Customers, sorted by Quartile's profits, in US$



From this curve, it seems an obvious choice to focus on reviewing the customers' performance in the quartiles HL_4 and LL_4. However, because HL_4 is a cluster of 5 parent customers (see Table 9), a more detailed analysis must be made by the Company to confirm or understand the reason for this result. These could be extreme cases as described in Table 7, and a different methodology of how to estimate their profits could be designed. The maximum profit is reached with companies in the first 8 quartiles. The segmentation of Parent Customers can be made even more granular. In this case, a more detailed analysis can be done using histograms instead of the quartiles, creating bins to group Parent Customers by Revenues, Gross Profits or Profit, as seen in Table 11 and Figure 4.

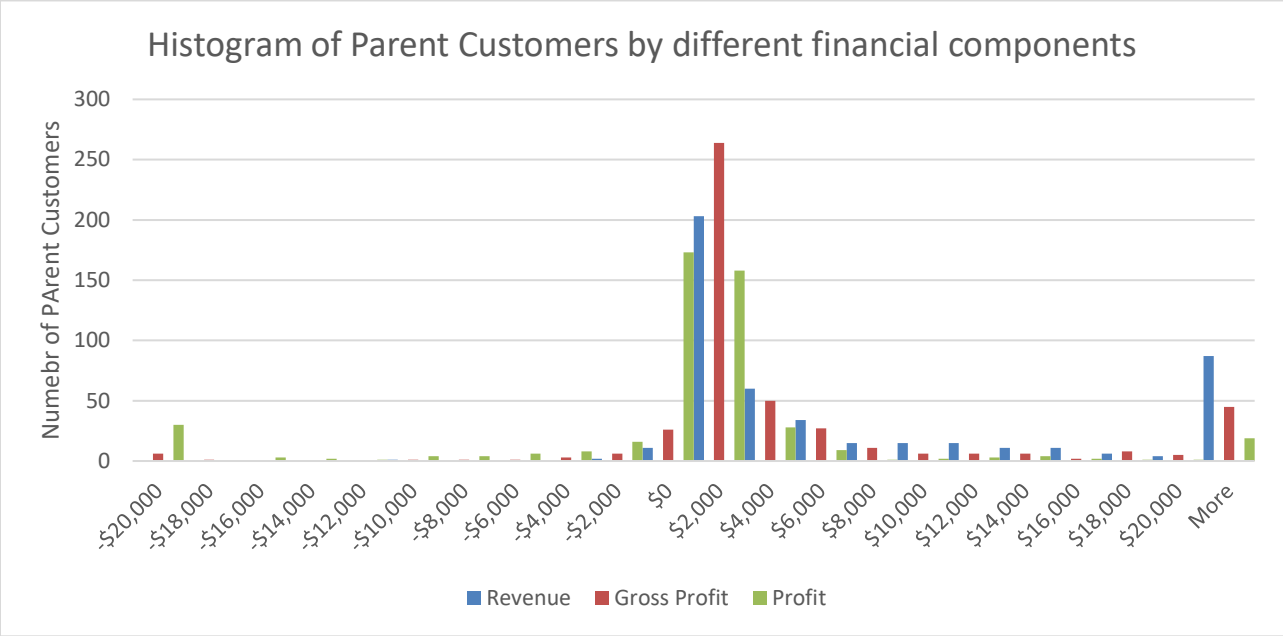
Table 11

Histogram of Parent Customer by Revenue, Gross Profit and Profit

US$	*Revenue*	*Gross Profit*	*Profit*
-$20,000	0	6	30
-$18,000	0	1	0
-$16,000	0	0	3
-$14,000	0	0	2
-$12,000	0	0	1
-$10,000	1	1	4
-$8,000	0	1	4
-$6,000	0	1	6
-$4,000	0	3	8
-$2,000	2	6	16
$0	11	26	173
$2,000	203	264	158
$4,000	60	50	28
$6,000	34	27	9
$8,000	15	11	1
$10,000	15	6	2
$12,000	15	6	3
$14,000	11	6	4
$16,000	11	2	2
$18,000	6	8	1
$20,000	4	5	1
More	87	45	19
Negative	14	45	247
% of Total Customers	2.9%	9.5%	52.0%

Figure 4

Histogram Distribution of Parent Customers by Revenue, Gross Profit and Profit



From Table 11 and Figure 4, there are some interesting observations:

1. the results appear to be normally distributed for each financial component: Revenues, Gross Profits and Profit;
2. the median is around -$2k to $2k for each one;
3. as described previously, at the extremes of the histogram, there is a group of Parent Customers that could be analyzed separately:
    a. too big in revenue to compare with the rest;
    b. 14 customers have negative revenues;
4. approximately half of the Parent Customers (52%) generate losses and 10% shown negative Gross Profits (meaning that the cost of sales is greater than the revenue, before operating costs are even considered).

As mentioned before, a negative revenue customer is an infrequent event, and it is not related with the commercial terms of the operation.

Because most of the Parent Customers have profits near the breakeven point (zero), they are very sensitive to cost allocation and the financial terms of the commercial relationship. This will have implications on the strategy to increase profitability.

If a Parent Customer is almost at break-even but pays in advance, it could be, from the financial point of view, a better customer than another with higher profits but that pays later with extended days of sales outstanding (DSO). The first type of customer may not to be pruned if cash cycle is considered. The second type is a candidate for a strategy to improve the cash conversion cycle, reducing the DSO.

4.3 Profit mapping by Services

Interport's ERP and its General Ledger system have 196 different services that can be invoiced to customers. To evaluate the profitability of each one, a profit mapping by type of service is done with a similar approach to the profit mapping of Customers in paragraph 4.2 above. We started by conducting a descriptive statistical analysis of the main financial components, as shown in Table 12.

Table 12

Descriptive statistics of the financial components of the Company P&L viewed at Services' perspective for 196 different types

		Sum	Min	20th	Median	Mean	80th	Max
Revenue	**US$**	25,607,360	(1,875)	957	9,275	130,650	82,933	5,236,852
Gross Profit	**US$**	10,281,064	(60,055)	593	6,499	52,454	59,032	991,101
Gross Margin	**%**	40		51	94	65	95	
Profit	**US$**	903,670	(841,524)	(9,518)	54	4,611	17,841	884,059
Net Profit	**%**	4		(226)	2	(361)	53	95
Lines	**#**	61,985	1	12	71	316	395	4,392
$/Transaction	**US#**	413	(69)	45	118	361	483	4,871

From the table we can highlight some characteristics. Because it is a very dispersed population, there are high and small revenue services; there are high and low gross profit services; some services are provided in many transactions and some are less frequent; some services are profitable, and some are not.

In terms of values, the median of the profit of services is $54 compared to -$16 of the median customer's profit, as seen in Table 7. This implies that the fraction of profitable services is bigger than the fraction of profitable customers.

An important issue arises when the data is analyzed from this perspective: there are five services with negative revenue. An assessment must be made if it is a mistake or if there are other issues leading to such result. Because this is a very small fraction of the total transactions (0.3%) it may be treated as an outlier of the data and do not impede the use of the profit mapping methodology to maximize the profits of the Company.

As shown in paragraph 4.2 for customers, a 2x2 matrix can be produced based on the Pareto principle for services (see Figure 5).

Figure 5

Services profitability map based on revenue and profits levels

PROFITS	Low-Revenue	High-Revenue
High-Profit	**LH** 5% of Services (10) 10% of Lines 6% of Revenue 14% of Gross Profit (87%) 4% of Cost to Serve (14%) 108% of Profits (59%)	**HH** 5% of Services (10) 17% of Lines 36% of Revenue 45% of Gross Profit (50%) 9% of Cost to Serve (9%) 360% of Profits (37%)
Low-Profit	**LL** 85% of Services (168) 53% of Lines 14% of Revenue 25% of Gross Profit (69%) 57% of Cost to Serve (94%) -237% of Profits (-58%)	HL 5% of Services (9) 20% of Lines 44% of Revenue 16% of Gross Profit (15%) 30% of Cost to Serve (17%) -131% of Profits (-11%)

REVENUES

To describe and understand Figure 5, we use quadrants HH and LL:

- In HH, 5% of the total 196 different services (10) are responsible for 17% of the transactions, generating 36% of the revenue and 45% of the gross profit of the Company
- In LL, 85% of the different services (168) are responsible for 53% of the transactions, generating 14% of the revenue and only 25% of the gross profit
- Additionally, 360% of the total company profits are generated by the services in the HH quadrant while -237% of the total company profits (mainly losses) are produced by the 168 services of the quadrant LL.

It is very important to highlight one main difference among these quadrants. The Cost to Serve of HH quadrant is 9% of the revenue. However, in the cluster LL, the Cost to Serve is as high as 94% of the revenue of these services. This could be the most important feature to look for as an explanation of the profitability of operations, clients, or services.

Applying the same methodology as described in the previous paragraph, a more detailed segmentation could be made using quartiles of the quadrants (see Table 13). This time, Services are used instead of Customers.

Table 13

Financial Components per Quadrant and Quartiles, by services

Quadrant	Services	Revenue	Gross Profit	Profit	Lines
HH	9	9,144,342	4,604,817	3,254,563	10,815
HL	9	11,097,225	1,689,876	(1,185,746)	12,278
LH	10	1,668,388	1,447,657	979,014	6,309
LL	168	3,697,405	2,538,714	(2,144,160)	32,583
Quartile	**Services**	**Revenue**	**Gross Profit**	**Profit**	**Lines**
HH_1	3	4,381,859	2,682,948	2,080,227	3,702
HH_2	2	963,875	750,443	643,732	616
HH_3	2	2,804,821	679,604	351,984	2,147
HH_4	2	993,787	491,822	178,620	4,350
HL_1	3	1,389,687	260,471	97,927	876
HL_2	2	1,069,660	561,021	(29,737)	4,619
HL_3	2	6,265,533	510,713	(221,211)	4,898
HL_4	2	2,372,346	357,671	(1,032,726)	1,885
LH_1	3	649,763	549,718	419,608	1,377
LH_2	3	379,323	359,183	282,882	1,091
LH_3	2	184,947	176,190	144,445	420
LH_4	2	454,356	362,565	132,079	3,421
LL_1	42	1,958,300	1,498,521	909,791	7,574
LL_2	42	224,826	179,134	50,802	2,198
LL_3	42	81,053	55,074	(29,915)	1,200
LL_4	42	1,433,226	805,985	(3,074,839)	21,611
Total	196	25,607,360	10,281,064	903,670	61,985

In this case, there are 12 quartiles with similar magnitude in terms of numbers of services that are represented in each quartile (2 or 3), while 4 quartiles each have more than 40 different services. Similarly, there is one quartile (LL_4), representing 42 of 196 services, that is responsible for 35% of the transactions, and with losses that are 3 times the net profit of the Company. Arranging the

quartiles by Profit, in descending order, we can estimate the contribution of the most profitable quartiles in comparison to the impact of the less profitable ones (see Table 14).

Table 14

Financial Components of Services' Quartiles, sorted by Profits

Quartile	Services	Revenue	Gross Profit	Profit	Lines
HH_1	3	4,381,859	2,682,948	2,080,227	3,702
LL_1	42	1,958,300	1,498,521	909,791	7,574
HH_2	2	963,875	750,443	643,732	616
LH_1	3	649,763	549,718	419,608	1,377
HH_3	2	2,804,821	679,604	351,984	2,147
LH_2	3	379,323	359,183	282,882	1,091
HH_4	2	993,787	491,822	178,620	4,350
LH_3	2	184,947	176,190	144,445	420
LH_4	2	454,356	362,565	132,079	3,421
HL_1	3	1,389,687	260,471	97,927	876
LL_2	42	224,826	179,134	50,802	2,198
HL_2	2	1,069,660	561,021	(29,737)	4,619
LL_3	42	81,053	55,074	(29,915)	1,200
HL_3	2	6,265,533	510,713	(221,211)	4,898
HL_4	2	2,372,346	357,671	(1,032,726)	1,885
LL_4	42	1,433,226	805,985	(3,074,839)	21,611

All Profits	106	14,385,543	7,990,600	5,292,097	27,772
All Losses	90	11,221,817	2,290,463	(4,388,427)	34,213
Total	196	25,607,360	10,281,064	903,670	61,985

All Profits	54%	56%	78%	586%	45%
All Losses	46%	44%	22%	-486%	55%

Eleven of 14 quartiles are producing positive profits, containing 54% of the total services (106 of 196), generating 56% of the revenue and 78% of the gross profit. Its contribution to profits is 5.9 times the total profit of the Company. Similar to the case when we create the quartile segmentation for Parent Customers, there are other quartiles from other quadrants different than the High-High

that also contribute with the total profit of the Company (LL_1, LH_1, LH_2, LH_3, HL_1 and LL_2).

Table 15 compares the contribution of the quartiles of Parent Customers and Services to the revenue, gross profits, profits, and transactions of the total company, segmented by positive and negative profits quartiles.

Table 15

Contribution of positive and negative profits quartiles, by Customers and Services

Segment	Customers	Revenue	Gross Profit	Profit	Lines
All Profits	51%	67%	89%	595%	43%
All Losses	49%	33%	11%	-495%	57%
Segment	**Services**	**Revenue**	**Gross Profit**	**Profit**	**Lines**
All Profits	54%	56%	78%	586%	45%
All Losses	46%	44%	22%	-486%	55%

As seen in Table 15, the segmentation is very similar for quartiles of Customers and Services that contribute in a positive or negative manner to the profits of the Company. Because of this observation, we explored other features to characterize which customers or services are profitable and which are not, and to use those features to design different strategies for maximizing profits to the Company.

A more detailed analysis was made to understand what the most profitable services are. We determine what are the Services that generate the top 80% for each of the following P&L lines: Revenue, Gross Profit, Positive Profits, and Negative Profits. We also calculated the number of transactions where those services were involved (see Table 16).

Table 16

Distribution of Services by Top 80% of the Revenues, Gross Profit and Profits

Pareto Top 80%	Revenue	Gross Profit	+ Profit	- Profit
Number of Services	19	30	19	33
Number of Lines	25,617	35,574	17,124	29,099
Percentage of Total Services	10%	15%	10%	17%
Percentage of Total Lines	41%	57%	28%	47%

Results from this analysis:

- 10% of the services are responsible for 80% of the revenues of the Company
- 15% of the services are responsible for 80% of the gross profits
- 10% of the services are responsible for 80% of the positive profits, and
- 17% of the services are responsible for 80% of the losses

We found that there are seven services that, while generating enough revenues and gross profits to be in the top 80%, are also in the top 80% of the negative profits: Ocean Freight, Customs Duties, Cartage and/or Drayage, Container Loading/Unloading, Order Processing Fee, Bill of Lading Fee and Pallet Charge Fee. The main reason is that the allocation of the cost associated with the Cost to Serve, converts a high gross margin operation into an unprofitable one.

This mapping reinforces the concept that there are a small number of Services (10 to 15% of the total listed) that are the most frequently provided by Interport to its Customers. Because of that, most of the cost to serve is allocated to them. As mentioned with extreme cases of Customers or Services, a more detailed analysis must be made to understand if there is a common reason, commercial or not, for this result. This will derive from the design of individual strategies to breakeven or maximize the profit from those operations.

This analysis is treating each service as independent of others. It is important to analyze if there are services that are bundled with others. Some of the results may be due to the fact that a

particular service is offered for a fee, determined by the market forces, that contributes to the gross profit but not enough to cover the operating costs. When other services are added to the first one, their revenue will cover the losses of the first one.

4.4 Profit mapping by Freight Mode

Because one of the main functions of the Company is being a freight forwarder, it seems logical to estimate the profitability of the common freight modes. As mentioned in paragraph 3.1.1, the Company had tried in the past to estimate the profitability of these type of services, with mixed results. In this paragraph we present P&L statements for each type of freight modes (see Table 17).

Table 17

Financial Components by Freight Mode: US$, % of Revenues and Average $ per line

Freight Mode	Total	Ground	Air	Ocean
Revenue, US$	25,607,360	3,568,469	2,876,970	19,161,921
Gross Profit, US$	10,281,064	2,323,767	1,180,745	6,776,551
Profit, US$	903,670	855,807	425,309	(377,445)
% of Total Revenue		14%	11%	75%
% of Total Gross Profit		23%	11%	66%
% of Total Profits		95%	47%	-42%
% of Total Lines		19%	13%	68%
Gross Margin %	40%	65%	41%	35%
Net Profit %	4%	24%	15%	-2%
Revenues , $/line	413	303	357	455
Gross Profit, $/line	166	197	147	161
Profits, $/line	15	73	53	(9)

Ocean dominates the business in 2019 with 68% of the lines or transactions, generating 75% of the revenue, and 66% of the Total Company Gross Profit. However, Ocean freight mode is generating losses when all the costs are allocated. Due to the high volume of the operation, the losses of -$377k, when expressed as an average per line, are near break-even: -$9.

There does not seem to be a direct relationship between freight mode gross margin and profits: Air mode has a Gross Profit per line of $147, which is lower than the $161 Gross Profit of Ocean freight, but Air freight generates $53 per transaction of profits compared to -$9 of ocean.

This might be due to the fact that this profitability analysis includes all the services or operations associated to each one of the three freight modes analyzed and not only the profitability of the transportation segment. The use of Warehousing and Distribution capacities (Cost to Serve) is available for all the freight modes. The allocation of these expenses is the main force behind the profitability of the freight modes and not the modes by themselves. Analyzing in detail each one of the Freight Modes by using the size of the profits of each Parent Customer, we can create a histogram of the distribution of customers (see Table 18).

Table 18

Histogram of Parent Customers by Profits and Freight Mode

Profits, US$	*GROUND*	*AIR*	*OCEAN*
$ (20,000)	8%	3%	5%
$ (18,000)	0%	0%	0%
$ (16,000)	1%	1%	0%
$ (14,000)	1%	0%	0%
$ (12,000)	1%	1%	0%
$ (10,000)	1%	0%	0%
$ (8,000)	1%	1%	1%
$ (6,000)	4%	1%	0%
$ (4,000)	1%	1%	2%
$ (2,000)	3%	5%	4%
$ -	34%	50%	34%
$ 2,000	29%	27%	40%
$ 4,000	5%	3%	6%
$ 6,000	3%	1%	2%
$ 8,000	0%	0%	1%
$ 10,000	1%	1%	0%
$ 12,000	1%	1%	0%
$ 14,000	1%	1%	1%
$ 16,000	0%	1%	0%
$ 18,000	0%	0%	1%
$ 20,000	1%	0%	0%
More	6%	3%	2%
Negative	54%	63%	47%

Note. A Parent Customer could be represented in more than one Freight Mode at the same time.

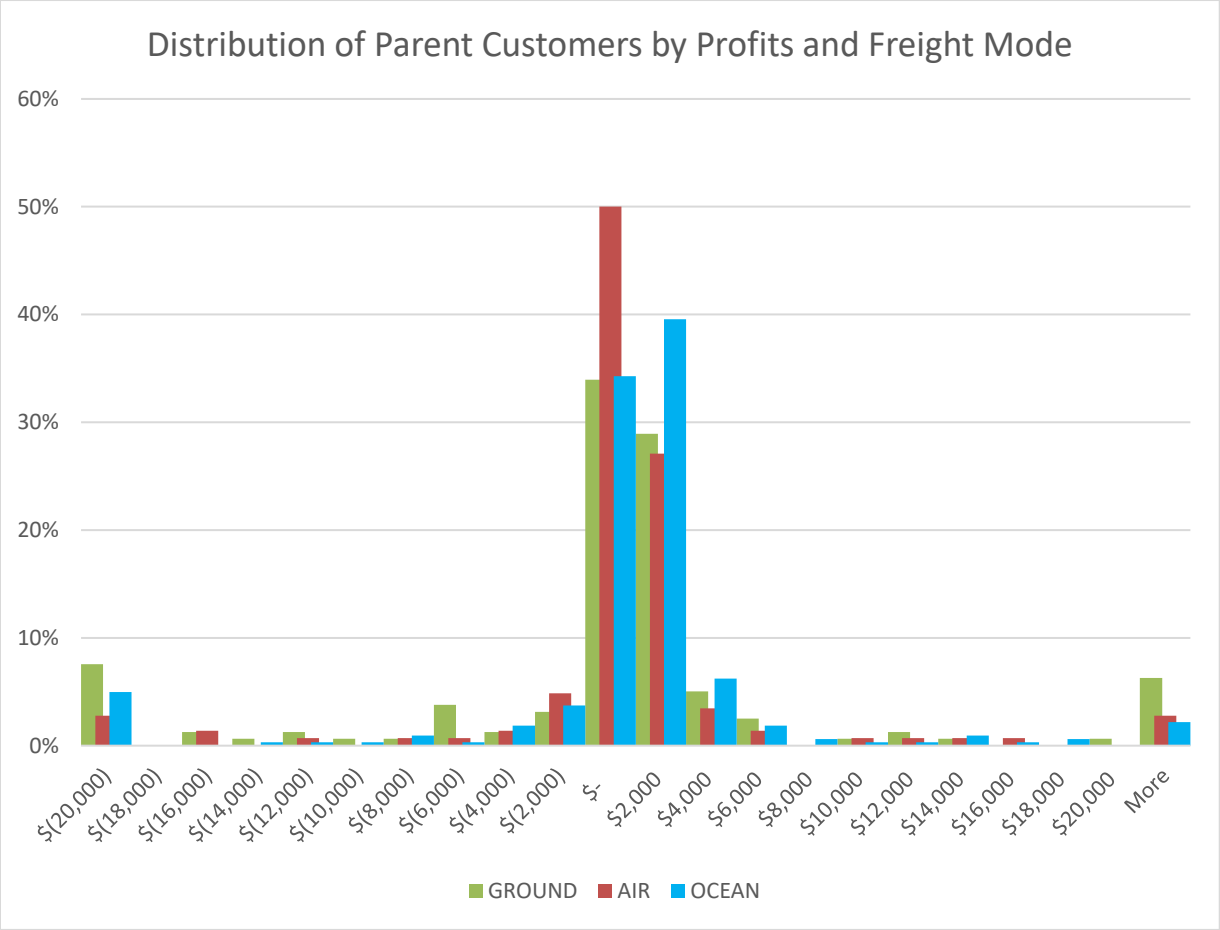
The key result is that 47% of Ocean, 54% of Ground and 63% of Air Freight of parent customers' shipments appear unprofitable. However, most of these shipments are almost breakeven in terms of profits. A sample of this almost breakeven-customers can be used to understand if the poor performance relates to i) the commercial terms of the freight mode (volume discounts, commissions), or ii) the cost allocation and the magnitude of the expenses that are being distributed.

Another possibility is that these shipments are not segmented by the amount of resources they are using from the company (labor and rent). This aspect is explored in the paragraph 4.5.

Figure 6 shows the same information in the form of a distribution. It is similar to Figure 4 in terms that the core seems to be a natural distribution with outliers in both extremes

Figure 6

Histogram Distribution of Parent Customers by Profits and Freight Mode



The median is between -$2k and $2k. It also shows extreme cases that might be outliers or Parent Customers with more complex commercial relationships. The median of the profits is near breakeven point in both vectors: distribution by customers' profits (Figure 4) or by freight mode (Figure 6).

4.5 Profit mapping by Direct Shipment

Direct Shipments are a type of operation that do not use Warehousing and Distribution resources. The profit margins associated with this type of operations are getting smaller with the commoditization of the freight's services, because freight is one of the major services offered in this type of operation. However, customers are requiring more added-value services, which usually fall within Warehousing and Distribution operations.

We build P&L Statements by segmenting the transactions by the type of service: Direct Shipment or Warehousing and Distribution (**W&D**). Then they are compared with the Total Company P&L either as percentage of the total costs or revenues, or as percentage of the revenue of each type of service (see Table 19). The analysis focuses on the differences on the cost structure of each type and how it translates into the average value of $ per line for each financial component.

Table 19

Comparison between Direct Shipments and Warehousing and Distribution P&Ls, as % of Total and % of Revenue

	as Percentage of Total			as Percentage of Revenue		
	Company	Direct	W&D	Company	Direct	W&D
Revenues	100	35	65	100	100	100
Cost of Sales	100	46	54	60	79	50
Gross Profit	100	18	82	40	21	50
Cost to Sell	100	27	73	4	3	5
Cost to Serve	100	4	96	24	3	35
G&A	100	34	66	8	8	8
Profit	100	62	38	4	6	2
Lines	100	24	76			

In this profit mapping, a Parent Customer may appear in both groups: Direct Shipment and Warehousing and Distribution. There are some very interesting findings from this segmentation:

- Both Direct Shipment and W&D are profitable types of services. They have a profit of 6% and 2% of the revenue.

- Direct Shipments comprises 24% of the total transactions, represented as lines in the ERP.
- The Gross Margin of the Direct Shipment operation is about 21% of the revenue, which reflects the problem faced by the Company of diminishing gross margins for basic operations as freight forwarders. Instead, Warehousing and Distribution has a Gross Margin of 50% of its revenue.
- Cost to Sell and G&A are similar for both types of services, as percentage of its revenues.
- 96% of the Total Cost to Serve is assigned to Warehousing and Distribution Operations. This is aligned with the fact that the rent of the warehouse is 9% of the total Revenue of the Company (Table 6) and that 76% of the transactions are of this type. For this reason, the Cost to Serve for Direct Shipment is 3% of its revenue, in comparison to 35% for W&D.
- While Gross Profit of the W&D transactions is 50%, the cost to sell and the cost to serve to operate W&D erodes the value down to 2% of the revenue as profits, when including the overhead costs as G&A compared to 6% of profits for the Direct Shipments.

Using the same data to build a P&L statement as average $ per transaction, we can have a sense of the order of magnitude (see Table 20).

Table 20

P&L of Direct Shipments and Warehousing and Distribution operation, as average $ per line

	Avg $ per transaction or line		
	Company	**Direct**	**W&D**
Revenues	413	590	356
Cost of Sales	247	466	177
Gross Profit	166	124	179
Cost to Sell	18	20	18
Cost to Serve	99	18	125
G&A	34	49	30
Profit	15	37	7

This is a major finding of the profit analysis by segmentation of the transactions by type of operation. The financial statements of the Company show the status and profitability of the whole company. Only using this allocation of the cost streams into each transaction allows us to highlight that, while the gross profit of W&D operation is almost 30% higher than the Direct Shipments (50% to 21% of the revenues), the Cost to Serve is 7 times higher ($125 to $18 per line in average). The net result is that, per line, the average Direct Shipment transaction has profits of $37 compared to $7 for the Warehousing and Distribution transaction.

A sensitivity analysis was performed to evaluate the impact of cost reduction initiatives to increase profits. Our finding was that a reduction of 10% of the Cost to Serve for W&D types of services can increase the company's profit by 65%.

4.6 Profit mapping of Parent Customers by transaction count

To assess if a Parent Customer that is serviced regularly generates more revenues and profits compared to a Parent Customer with occasional or infrequent operations, we developed a profit mapping of the Parent Customers, by the amount of lines recorded in the ERP in 2019. We then built a histogram to divide them by amount of transactions per year in bins of 10 (see Table 21, Figures 4-7 and 4-8) and create a cumulative revenue, gross profit, and profit curve.

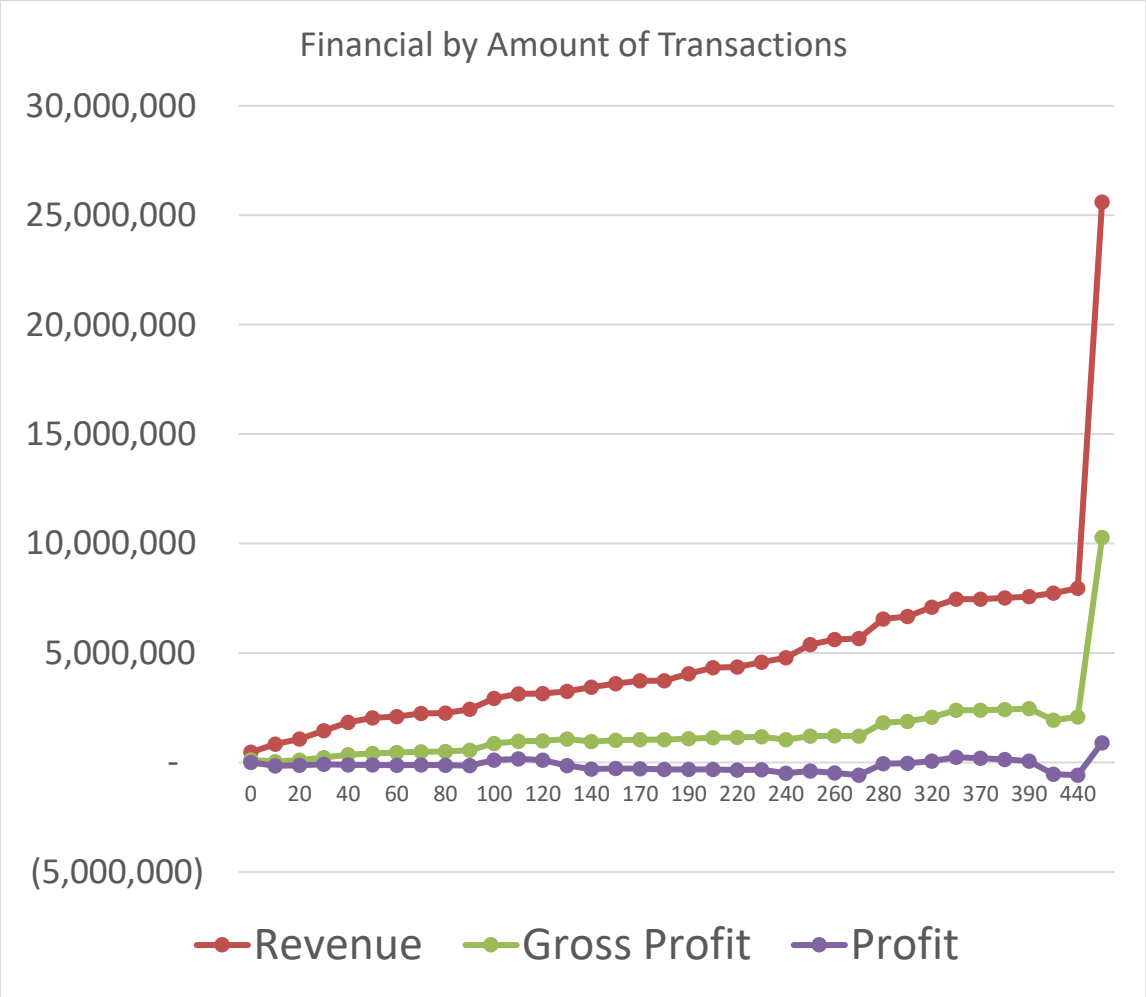
Table 21

Cumulative Revenues, Gross Profits and Profit of Parent Customers by amount of transactions

Transactions	Revenue	Gross Profit	Profit
0	468,352	121,079	4,790
10	843,404	38,177	(148,641)
20	1,069,134	112,081	(123,628)
30	1,460,260	231,428	(77,044)
40	1,836,406	363,752	(114,751)
50	2,032,326	421,744	(113,347)
60	2,098,178	454,613	(119,187)
70	2,245,392	492,182	(111,298)
80	2,256,628	498,767	(118,951)
90	2,439,927	567,551	(135,445)
100	2,929,972	874,273	108,362
110	3,134,298	977,320	164,999
120	3,148,419	986,949	115,247
130	3,248,837	1,077,510	(133,646)
140	3,435,443	960,763	(302,873)
160	3,609,010	1,020,474	(277,867)
170	3,735,266	1,045,760	(292,460)
180	3,739,672	1,048,951	(308,472)
190	4,056,926	1,082,092	(318,515)
210	4,336,639	1,133,127	(320,159)
220	4,360,492	1,146,834	(337,922)
230	4,584,574	1,175,575	(330,110)
240	4,787,030	1,042,777	(494,094)
250	5,387,409	1,200,061	(395,770)
260	5,618,838	1,226,756	(480,454)
270	5,661,450	1,208,255	(577,363)
280	6,562,034	1,816,398	(47,216)
310	6,666,274	1,880,157	(34,485)
320	7,093,215	2,072,753	65,239
340	7,459,614	2,390,799	238,527
370	7,464,496	2,395,328	201,249
380	7,514,696	2,414,646	143,079
390	7,578,645	2,458,762	58,343
430	7,740,148	1,942,794	(535,760)
440	7,952,838	2,083,727	(576,115)
500	25,607,360	10,281,064	903,670

Figure 7

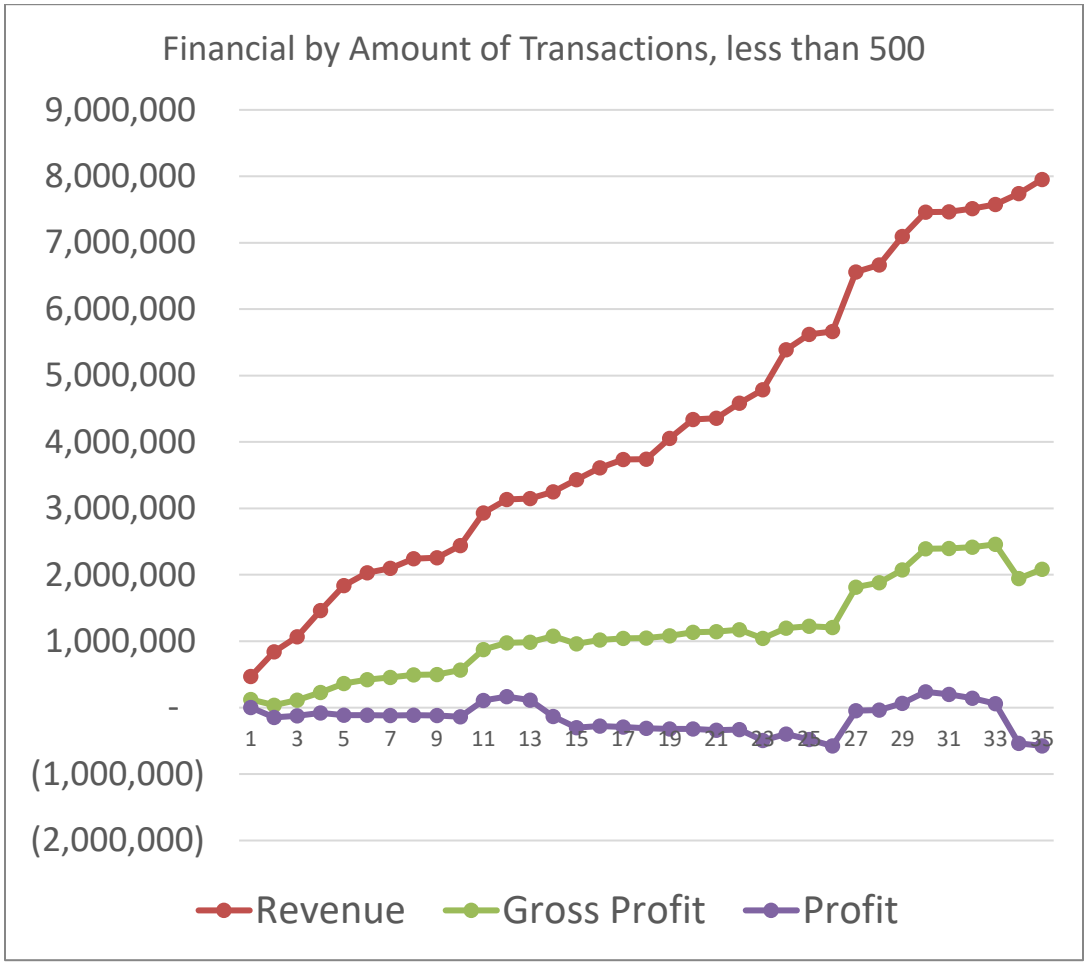
Cumulative Revenues, Gross Profits and Profit of Parent Customers by amount of transactions



There is a distinctive behavior of most of the Customers (those with less than 500 transactions per year). These accounts for 453 of the total 475 parent customers (95% of the total but only 30% of the total transactions). The remaining 5% of the customers are responsible for 70% of the transactions. To analyze the first cluster, we trimmed the dataset to those customers with less than 500 transactions per year (see Figure 8).

Figure 8

Cumulative Revenues, Gross Profits and Profit of Parent Customers with less than 500 transactions per year



This graph shows that adding customers with more transactions increases the total revenue of the Company, but there is no correlation with the generation of net profits.

Both graphs are displayed to focus on the impact of those customers that have less than 500 transactions per year compared to the few above that level.

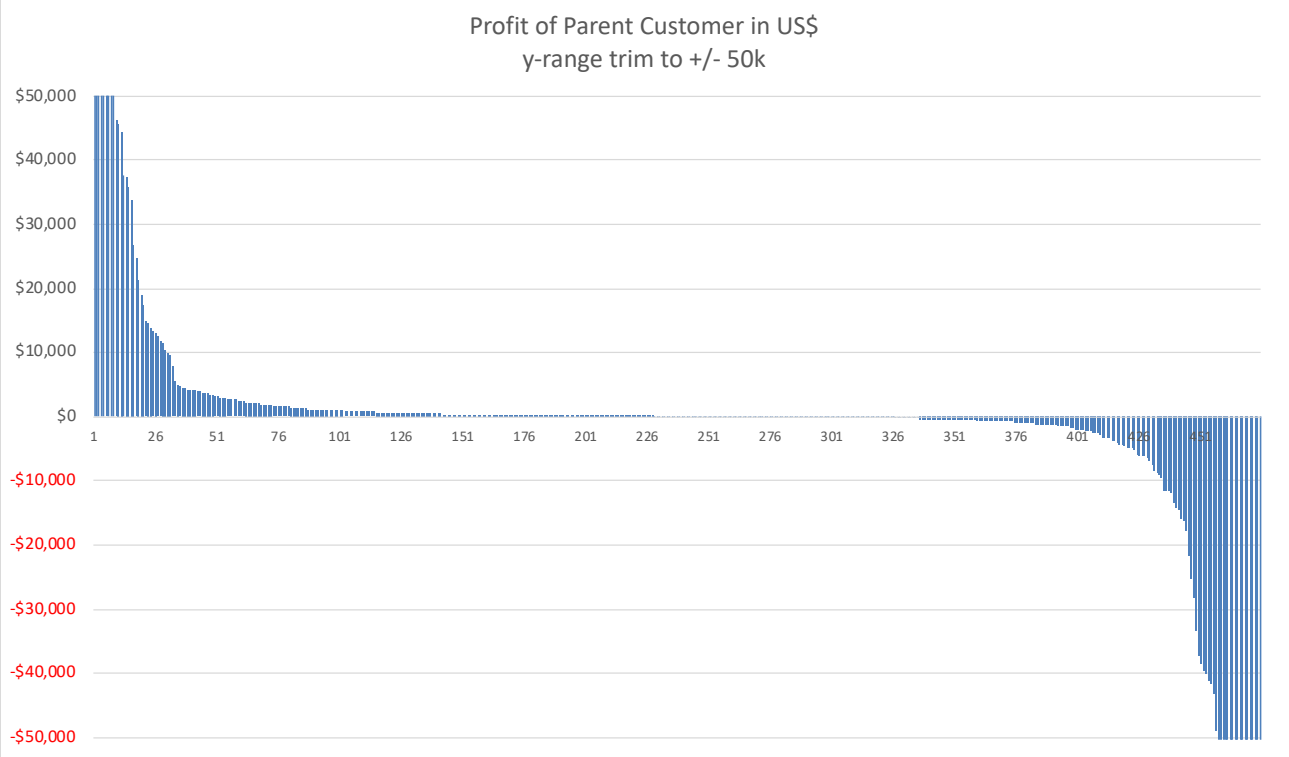
The Company may analyze if there are non-commercial issues with the customers above 500 transactions per year, or it is a matter that the economies of scale that may generate advantages for them in terms of cost per volume, are not covering the Cost to Serve of some of the operations required to serve them.

4.7 Relation between Gross Profit per Line and Net Profit per Line

One of the main problems that Interport faces is how to correlate the gross margin that a business generates to the profitability of the company, a customer, or a business unit. Before exploring if there is such correlation, we ordered all the 475 Parent Customers based on the profit size, from the highest profit to the highest loss, and create a graph to compare the magnitude of each one (see Figure 9). The y-axis has been trimmed to have profits in the range of -$50k to $50k

Figure 9

Profit per Parent Customer arranged in descending order



From this graph it is evident that there are many Parent Customers with profits very close (above or below), to the breakeven line. The same type of behavior is shown in Figure 4.

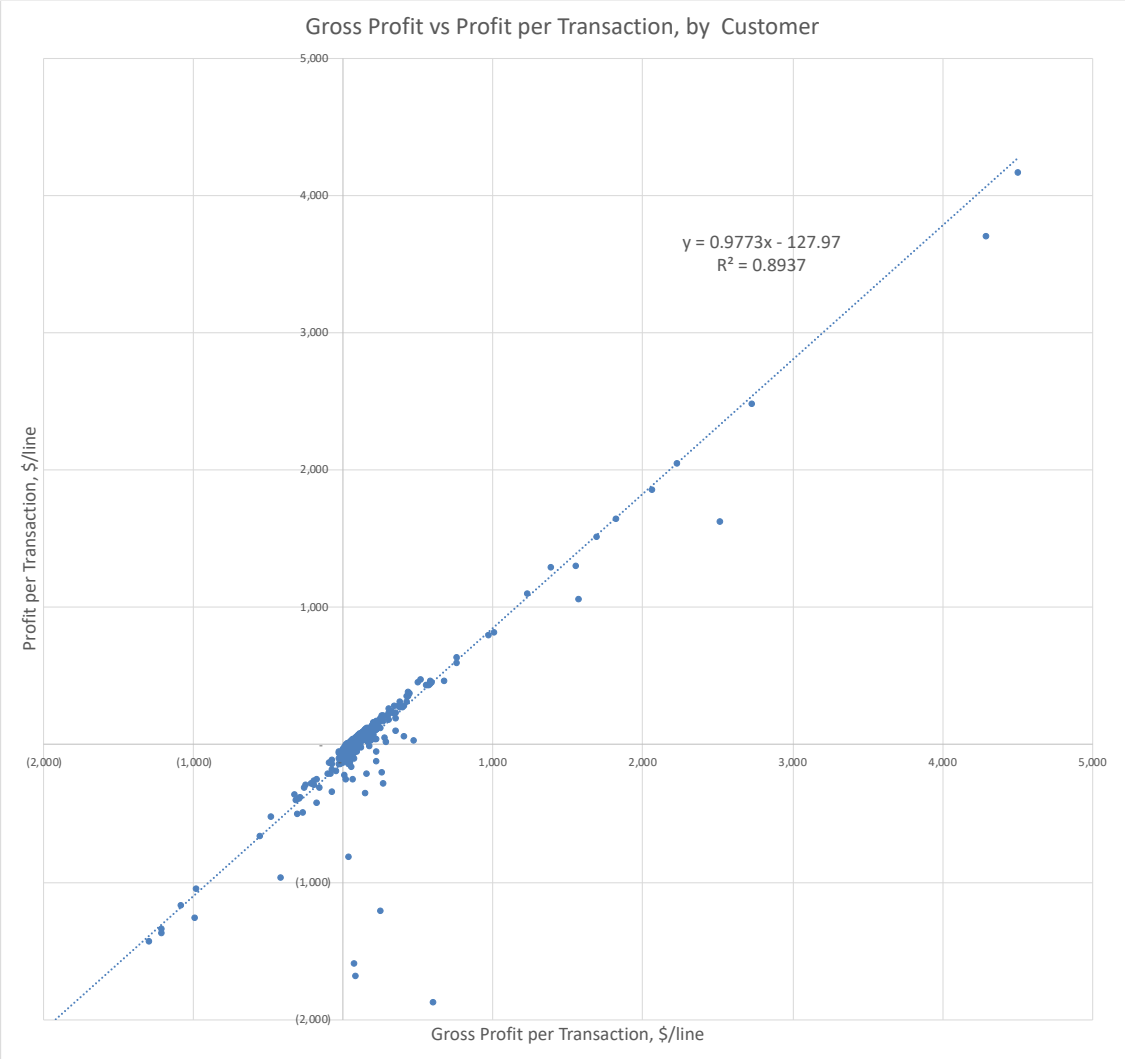
Because the profit is the result of the allocation of the cost components as described in the methodology chapter, for the many customers near breakeven point, a further analysis may serve to determine if there is a minimum of Gross Profit per transaction that convert many of the

customers that are close to breakeven, to profitable. The gross profit is easy to determine from market conditions: price and cost of services sold. However, profit per customer is a very complex task, as described in the methodology chapter of this project.

We compare, by Parent Customer, the average gross profit per line with its corresponding profit per line (see Figure 10).

Figure 10

Correlation between Gross Profit per Line and Profit per Line, by Parent Customer



It appears that there is a strong correlation between those two variables. This suggests that there is a minimum of approximately $130 average gross profit per line needed to break even in net profits.

The advantage of this concept is that the gross profit is easy to determine and instead of allocating costs, a simple rule can be used to estimate profits per line.

The average gross profit per line is constituted by many services. Some of those services are priced above the $130 per line average, and some below. To further evaluate this result, we calculated how many Services are priced below the $130 average of Gross Profit per line: 118 services that represent 60% of the total 196 described in the ERP and general ledger.

5 CONCLUSIONS AND RECOMMENDATIONS

The allocation of costs using activity-based costing (ABC) at a transaction level provided a potent analysis tool to assess the financial performance of the Company by various features (referred to as vectors). In this chapter we provide recommendations on how Interport and other companies in the industry can prepare for, and facilitate, accurate profit analysis based on activity-based costing. The P&L analysis enabled by the detailed ABC approach also provided insights, which we translate in this chapter into actionable recommendations for Interport specifically and, more generally, for the companies in the third-party logistics industry. We conclude our recommendations with improvements to the model that could be made by researchers seeking to further this field of study.

5.1 Methodology recommendations

For effective data analysis, company's database should be built with clear traceable relationships between constituent entities, which should be reflected in an entity relationship diagram (ERD). The entity relationships should be enforced at the data entry level, for example, all costs recorded and charges created should be linked to individual transactions and underlying activities. Most of the complications encountered during the data analysis stage of this project involved mismatches of datasets due to the lack of consistency in the entity relationships. Therefore, we recommend that any revision of the existing service offering is conducted based on a coherent ERD.

A specific example of the improvement to the data structure would be to create a clear traceable link between services and the corresponding revenue and costs. This will enable accurate cost allocation and profitability mapping of the customers and services. The adoption of the general ledger-defined activities in this project provided a direct link between a customer and the revenue based on the invoice records. In contrast, the linkage of the revenue to services is constrained by the fact that the Company currently groups transaction types into broader categories, creating a cost-to-invoice mismatch. In this project, for the lack of a better service cost driver, we used the

existing revenue distribution to transactions in the invoices as the activity driver for direct cost allocation (see paragraph 3.4.2). This is not a preferred option, as it makes the definition of direct costs circular after the price for services (and the revenue) is made dependent on the cost allocation. The data structure needs to match variable costs (COGS) directly to the internal invoice records, enabling traceability of the direct costs to the transactions and then to the customers and service types, and improving the accuracy of the profitability information.

Creating internal cost-plus pricing model

We recommend that companies operating in the third-party logistics industry create and maintain transaction-level break-even price records, using the direct cost traceability and ABC for the overhead costs. Maintaining such records allows the company to trace the profitability of a customer based on the current prices/rates as well as to establish a cost-plus pricing strategy (at a company-facing level) to set the profitability of the customer to a desired level by adjusting the margin. A company may decide, for tactical or strategic reasons, to sell services at a loss (set negative profit margins). Any loss of profits would then be a data-driven, informed decision of the management. This is instrumental for bundling services into profit-making offerings or pricing-out unprofitable customers as discussed later in this chapter.

Importantly, the internal cost-plus pricing method should not automatically translate into a fully transparent client-facing invoice. This way the Company can maintain any existing high-margin offerings or customers, and at the same time create a data-supported explanation of rates/price increase for unprofitable customers. It is recognized that the market prices may prevent such price increases, however if loss-making market prices persist over a long term, the Company should consider discontinuing the service in question.

Definition of service types

The overhead cost allocation model proposed in this project could be further leveraged by Interport to track the profitability of the re-defined service groups. The company-proposed labels for service types were not supported by the dataset entries such as warehouse receipts and part numbers entries (discussed in paragraph 3.4.6). As a consequence of this inconsistency, the Company needs to re-validate its data-creation process and its operations, which is likely to involve adjustments to the data structure. Once this irregularity is resolved, the Company can consider more objective service types for its profit mapping, such as:

(a) Direct shipment transactions would be transactions with no warehouse receipt entry.

(b) Pallet-in, pallet-out transactions that utilize warehouse resources (primarily loading/unloading and storage functions) would be transactions with warehouse receipt entry but no part numbers.

(c) Distribution transactions, which involve pick and pack activities (most labor-intensive), would be transactions with warehouse receipt and part number entries.

In any event, the service type categorization should be based on mutually exclusive and collectively exhaustive features in the data structure.

5.2 Profit mapping recommendations

We recommend that companies using cost allocation methodologies conduct analysis of profitability at a transaction or operation level. This allows them to inspect the data and results from a financial and transactional perspective. It also makes possible analysis of the outliers for data cleaning and explaining the observed behavior.

Building a P&L per transaction is fundamental in enabling segmentation by various features (vectors), such as customers, services, modes of transportation or a combination of the features.

The profit mapping shows that an entity (services or customers) with high gross margin can still lead to a net loss if such an entity is responsible for extensive usage of a high-fixed-costs service.

The allocation of the Cost to Serve dominated by the cost of running the Warehousing and Distribution facilities and equipment as well as other fixed assets, is the key factor affecting the profitability of an otherwise high-gross-margin Warehousing and Distribution business unit. As a result of this dynamic, Interport does not achieve the desired increase in net profitability by extending its Warehousing and Distribution service offering. Although the gross margin percentage of this business unit is higher than for the Direct Shipments, the resources used to deliver Warehousing and Distribution services are responsible for most of the Company's fixed costs. After these costs are allocated exclusively to the entities (services and customers) using the warehouse, in most cases, these entities are rendered borderline or even unprofitable. In contrast, Direct Shipments, despite having very high direct costs, generate better net profit margins.

The profitability analysis at a transaction level also allows the company to estimate the expected average gross profit for clusters of customers or services from a variety of perspectives: customer type or number of transactions generated, freight mode or group of services. For example, contrary to the expectation of Interport, there is no evidence that the profitability of a customer depends on the mode of transportation, its size or level of activity. However, these vectors are still important in improving the Company's overall profitability, as service bundling and/or targeted price increases can turn a loss-making entity into a profitable one.

We also recommend using transaction-level profitability analysis methodology to identify the most expensive resources/activities in a company. An optimization of costs for these activities can dramatically increase the profitability of the unit consuming these resources. For example, a 10% reduction of the total Cost to Serve for the Warehouse and Distribution can increase the company's profit by 65%.

5.3 Treatment of unprofitable customers

We do not recommend outright pruning of the customers that appear to be low-profit or unprofitable based on the profit mapping analysis. In the context of the Company, a reduction of the number of customers will reduce the revenue more than the cost of operation. Instead, we recommend the companies to use levers identified in profit mapping to increase the profit margins for the near-breakeven operations.

A company should seek to upsell customers using standalone loss-making services (due to high cost of operation) to use a package of services bundled with high-profit-margin elements. By offering pre-designed service bundles a company can generate enough gross profits to ensure that the profitability from that customer remains above the breakeven line. The same approach should be applied to onboarding new customers.

A company can leverage low-gross-margin operations that have high transaction volume, such as Ocean Freight (with the largest transaction volume compared to other freight modes), by bundling the carriage service with other higher-profit-margin services. Alternatively, customers that do not take up more financially sustainable services may eventually need to be priced-out from the customer portfolio.

As discussed earlier in this chapter, a company can utilize a cost-plus pricing model to increase the prices/tariffs to ensure that its service offering is profitable. We recommend applying price differentiation between customers based on the relative market power of the 3PL provider and its customers and well as the profitability of the entire service package used by the customer. Different strategies should be designed for each of the customer clusters, for example, differentiating near-breakeven customers with large transaction volume and near-breakeven customers with low transaction volume.

Another reason for exercising moderation in revising the customer portfolio based on profitability is that the bulk of borderline customers play a major role in the cost structure by absorbing the fixed costs (rent and some labor) that would otherwise be reallocated to the few remaining customers, in turn reducing their profitability. In addition, a customer that generates high revenues but low net profit margin can still be a valuable customer if it pre-pays for the services. Such a segment of customers (common for consolidation services) is providing an interest-free working capital, thus reducing the total cost of capital for the Company.

5.4 Areas for improvement and further research

Further iterations of this research or new research using a similar type of methodology could benefit from the following improvements.

The accuracy of the cost allocation model can be improved by applying a volume-weight activity driver for air freight-related costs, as opposed to uniformly applying cubic volume (relevant to ocean and ground freight) as the activity driver to all freight modes.

The activity-based costing models should avoid using revenue as the activity driver. Otherwise the accuracy of cost allocation will be reduced due to the circular definition of the activity driver rates. The purpose of cost allocation is to link the revenue to the underlying cost; however once the cost allocation is defined by revenue, a larger increase in cost allocation will lead to an ever growing pressure to increase the service price.

The profitability mapping of customers and the customer portfolio management can be further enhanced in subsequent studies by incorporating into the transaction's profitability the cost of capital, which will be driven by the customer payment terms or the days of sales outstanding (DSO). The customers with a high DSO would have an even higher true cost for the company, whereas customers with high revenue stream and advance payment terms would provide savings in the cost of funding working capital and would contribute to a higher profitability.

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