Implementation of New Delivery Platform on Retailer's Distribution Center

Sponsored by: Home Improvement Retailer via Georgia Tech Panama Logistics Innovation & Research Center

Masters of Science in Supply Chain Engineering

Capstone Project Report

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1. Executive Summary

Retailers are operating under pressure to ensure that their promises are satisfied by their supply chains. Efforts to leverage innovation, faster delivery methods, and customer behavior information are being combined to enable convenient, consistent, and cost effective last-mile distribution systems. Retailers have been exploring implementing omnichannel initiatives to capture demand for all types of customers, regardless of their behavior and whether they are a "pick up in the store or have it delivered" kind of client.

While omnichannel retailers tend to focus on the customer experience of a seamless integration of an e-commerce channel and a network of *"brick-and-mortar"* stores, on the back-end, most of them are still trying to adjust their distributions networks to be capable of fulfilling a now broader spectrum of customer expectations with some consideration for their profit margins and working conditions for their staff. Clearly, omnichannel is critical to give the customers what they want, when they want it, yet there's not a blueprint of how companies can integrate the marketing and the operational side of an omnichannel strategy to support business growth.

This project aims to analyze the situation of a home improvement products retailer located in Panama currently implementing a new digital delivery platform that will allow for the systematization of their delivery planning process and its integration with their e-commerce platform and physical network of stores as part of their omnichannel strategy. We assessed the past conditions of the retailer's distribution system to generate an "as-is" scenario where delivery planning was mainly coordinated manually. Taking this scenario as basis, we documented and analyzed all situations that arose from the implementation of the new delivery platform as a streamlining mechanism and its integration with the electronic commerce system to contrast this new process with the best practices surrounding omnichannel initiatives from similar businesses to address any difficulty presented during this transition. Furthermore, we estimated the benefits of implementing the digital delivery system (expected to integrate routing systems, sequence client's deliveries, and optimize the fleet) for their distribution capacities as part of the development of a framework for implementing an effective omnichannel delivery planning based on the findings of this project.

2. Sponsor Overview

"Home Improvement Retailer" is one of Panama's biggest retail companies and the preferred home improvement store in the local market since its beginnings in 1990.

Promoted as *"the leader in solutions for your home",* the company's catalog includes: appliances, building materials, hardware, outdoor living, lighting and ceiling fans, paint, plumbing, gardening, and furniture, among other items. Although most of the deliveries in one of two categories: construction material and general products. Currently, "Home Improvement Retailer"'s delivery orders (around 100 per day on regular season and over 200 around December) are fulfilled by its Distribution Center, located in Chilibre (about 18 miles from the center of Panama City), or one of its 25+ stores distributed all around the country, depending on inventory availability.

In an effort to improve customer service, reduce costs in *"last-mile"* delivery, and standardize its delivery process, the company recently decided to shift away from a manual delivery scheduling system onto a new digital delivery planning platform that will allow for a more efficient distribution system. The platform takes into account historical traffic data from Google, requested delivery windows, customer's locations, and fleet size to establish daily delivery routes that can be monitored and modified in a lively manner.

Once a route has been established, the new platform will be accessed through a mobile application to be used by "Home Improvement Retailer" and its supplier's trucks. *"Home Improvement Retailer" hopes the platform helps sustain their growth*, as the company continues to increase its presence both physically, through an expanding network of stores, and electronically, where an estimated internet penetration of 67%[1], 83% mobile subscriber penetration (tied for first in the region), and 63% smartphone adoption[2] (third in the region) in the isthmus show that Panama has the necessary conditions for the development of a thriving e commerce market.

3. Project Objectives

- Propose a framework for the implementation of a digital delivery planning platform in an omnichannel retail supply chain environment.
- Present a clear assessment of the initial situation of the retailer's assessment prior to digitizing their delivery planning process for both, online and physical channel.
- Research, evaluate and recommend additional practices to be considered by the sponsor for the further refinement of their distribution system.
- Quantify the distribution capacity improvement as a result of the implementation of the system.

[1] Internet World Stats. "*Latin American Internet Usage Statistics"*. Internet World Stats: Usage and Population Statistics, December 2018, Miniwatts Marketing Group. https://www.internetworldstats.com/stats10.htm

[2] GSMA Intelligence. *"The Mobile Economy Latin America and the Caribbean"*, December 2018, GSM Association. https://www.gsma.com/latinamerica/wp-content/uploads/2018/12/Mobile-Economy-2018-ENG.pdf

4. Industry Relevance

"Home Improvement Retailer"'s ordering systems, fulfillment, and returns are affected by the implementation of the new delivery platform; with the addition of it, the company hopes to now adapt their logistics operations to address omnichannel expectations influenced by evolving client engagements, including:

Standardizing Routing: Current delivery orders are grouped in an in-house delivery request software that its fed by the stores and online orders with the information about client orders and delivery locations. Route planning then is based on standard cluster zones (segmented regions throughout the country) with the added responsibility to account for prior uncompleted deliveries and claims. The newer process will take advantage of the delivery platform to plan routes in a more standardized way that takes into account vehicle size, delivery windows, traffic, and working hours in a systematic way and not in an ad-hoc manner.

Attention to Delivery Windows: Businesses need to deliver on promises about same-day or next-day delivery (or far stricter than these). The project's sponsor plans to implement a delivery window for clients of around 1-2 hours (current delivery speed is next day at the very least and subject to limitations on delivery permits of apartment complex, business offices and construction sites). Reducing the delivery windows will add new constraints to the routing modelling.

Platform Integration: E-commerce and order management systems are synced on some level, but the added connection with the delivery system will trigger additional tasks to be performed to account for a better management of the inventory and fulfillment performance in general. Seamless flow of information is needed for proper prioritization and timely decision making.

Improved Timeliness on Decision Making: Current tracking of trucks and decision making is supported by phone communication between the driver and the contact center (who is responsible for contacting the client and informing him of any delays). The newer platform has an app version to be used on mobile devices providing two way communication with drivers, logging of events and live tracking. The added visibility of the location of the truck will allow the distribution team to be aware of any delays or situations that may affect the deliveries, and to make decisions in a more lively manner to properly address such events. Beyond that, the new platform could add a new layer to customer

engagement by enabling shared real-time and ETA status which could also reduce the need for preparation calls done to validate customer presence at the moment of delivery and exact location.

5. Analysis of Delivery Process

a. Original Delivery Process - General Description

The distribution system for “Home Improvement Retailer” currently feeds 25 physical stores located all throughout the country, online orders received via their e-commerce platform and commercial orders (special orders that are associated to requested material to be sold directly to a client). Around 5,500 lines are picked per day on the distribution center, which includes two warehouse designated “CHILIBRE 1” and “CHILIBRE 2”. The later one includes four bays specifically designated for deliveries to direct customers.

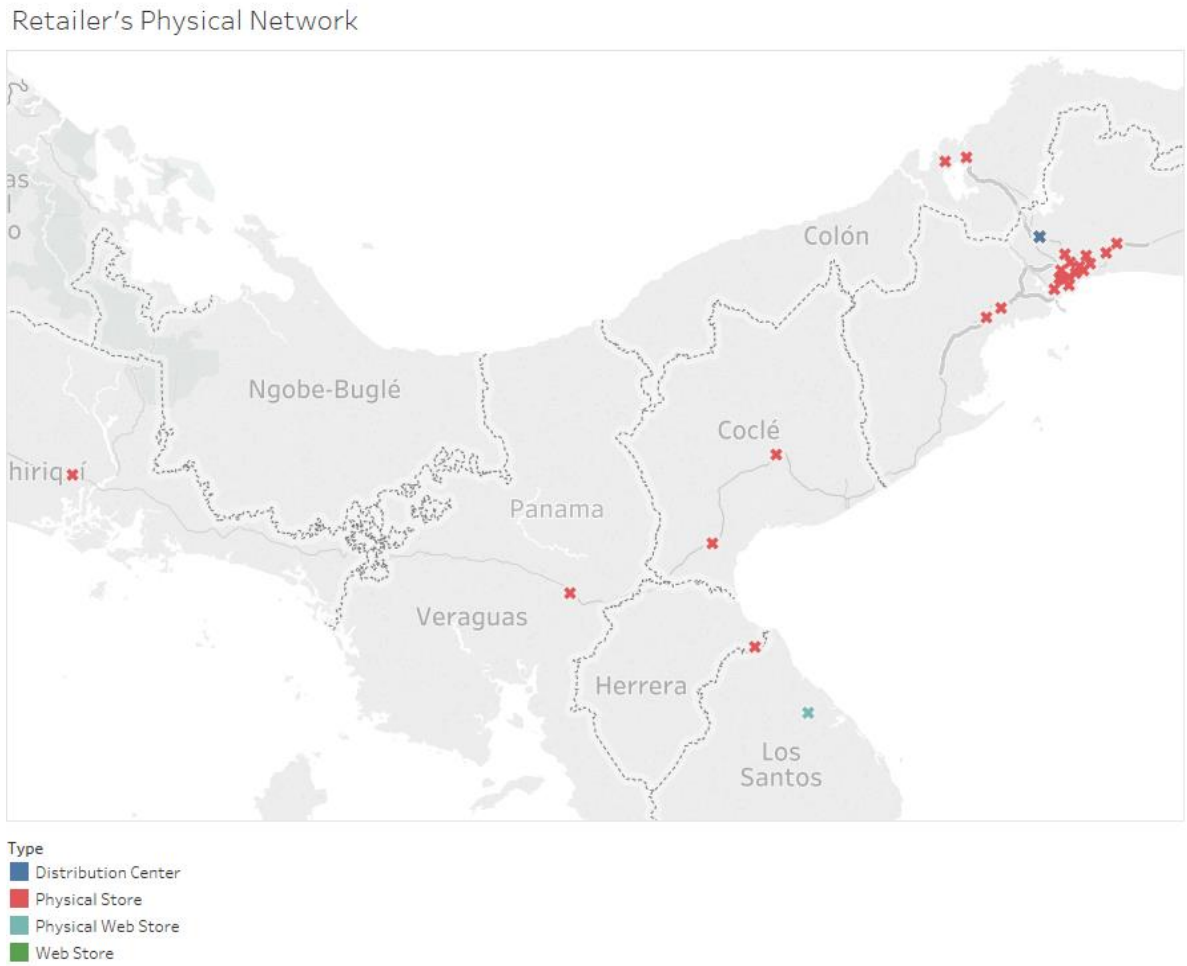

Figure 1. Retailer's network of stores and distribution center

Every customer delivery order for the metropolitan zone is planned and fulfilled from the distribution center (DC); with some exceptions depending in inventory availability, when inventory retrieval from other stores may be scheduled and completed days prior to the delivery date or on the delivery date, as one additional stop for delivery trucks while on their route. Deliveries for orders from countryside's stores are planned and fulfilled mainly from the stores.

The distribution center handles four types of orders, which define the programming code for its delivery planning, as stated below.

Table 1. Programming Codes for Deliveries – Internal retailer's classification

Programming Code (Delivery Type)	Detail
1	Orders to be picked at the store and then delivered to the client.
2	Fulfilled by the DC for client pickup in the DC (Chilibre)
3	Fulfilled by the DC for direct delivery to client site
4	Fulfilled by the DC for customer pickup at store

On top of the four delivery types currently set up in the DC's delivery planning platform and their WMS, online orders for pick-up at the stores (fulfilled with items on the stores) are also managed by the organization, although the DC has no visibility over these orders. Online orders set for direct-to-client deliveries will be classified as delivery type 4.

Transportation is performed by a combination of private and subcontracted vehicles. For deliveries going directly to the client, the organization uses 20 ft long trucks, vans and platforms (for construction material); while orders delivered for customer pickup at the stores are usually loaded and transported on 40 ft long containers where they are combined with product to be stocked on inventory at the stores. Orders for customer pickup at the stores are planned to allow for the inventory to be at the store before the opening hour at the store on the promised delivery date.

Currently, next day delivery is the faster direct delivery option (cost still remains the same, regardless of the time allowed for the delivery) offered by the organization, but depending on the time the order is received it might not be available for clients, as it will be further explained in section 5.a.i.2. A delivery window (specific requested time for delivery) is not

formally been enforced right now, although planners try to accommodate special requests from customers that might ask for a specific delivery as they defined the stop sequence for the particular route that includes these orders. To sum up, the DC plans and executes its distribution activities to comply with a requested delivery day and not necessarily an specific delivery window within that day.

When all delivery requests have been grouped by delivery zones and assigned to a vehicle, a route plan is defined for each of these. Although the route plan is defined before the delivery day, the drivers might ask for changes in loading sequencing based on how they plan to tour the route, while loading operations occur, which typically happens at the beginning of each day.

After departure from the DC, vehicle monitoring while on-route is done via calls between the DC's contact center (formed by a team of 5 people), the client and the general helper on each vehicle. Moreover, as the vehicle approximates the delivery location, the contact center coordinates a conference call between the client and the vehicle's general helper to get specific details about the delivery address. Everyday around 500 delivery related calls are registered by the contact center.

Finally, when the delivery is completed, the client is requested to sign a hard copy of the route plan to serve as proof of delivery (POD).

i. Information Flow for Original Delivery Process

The timely execution of the tasks associated with the delivery of a product require readily available information. The following table depicts the information generated as part of this process as well as its dependence. In the following sections each of these tasks will be further described.

Table 2. Description of Original General Delivery Process

#	Task	Dependence	Responsible (Headcount)	Key Data Generated	Associated Software / Record	Estimated Time
1	Quote	● SKU Creation ● Sale	Store / E-commerce Platform	● Quote Number ● Client ● SKU ● Store	SAP	N/A

2	Delivery Programming	• Quote	Service Desk Clerk (25) / E-commerce Logistics Analyst (2)	• Delivery Programming ID • Route ID • Type of Delivery • Address	Delivery Planning Platform	10 - 15 min
3	Delivery Planning	• Delivery Programming • Inventory Retrieval from Stores • Claims	Route Planner (1) / Store Dispatch Planner (1)	• Delivery Plan Number • Route Plan • Delivery Vehicle • Driver	Delivery Planning Platform	240 - 360 min
4	Order Approval	• Delivery Programming • SKU Creation • SKU Allocation	Client Planner (1)	• Wave Number • Picker	WMS	1 - 5 min
5	Order pick	• Order Approval	Picker (1)	• Container ID	WMS (Putty)	N/A
6	Loading	• Delivery Planning • Order Approval	Dispatch Verifier (Buffer) (1)	• Master Container ID • Load Bay • Loaded Truck	WMS (Putty)	20 - 75 min
7	Delivery	• Loading	Contact Center (4), Driver (12), and General Helper (12) / Store Truck Drivers (4*)	• Event Report • Affected Client	Delivery Planning Platform	15 - 20 min
8	Inventory Retrieval from Stores	• Delivery Programming	Service Recovery Assistant (1)	• Store for Pickup	Off Platform Report	N/A
9	Claims	• Delivery	Service Recovery Assistant (1)	• New Delivery Date • Request for Order	Off Platform Report	N/A

				Approval		

1. Quote

Once a sale that includes a delivery is completed at the store / e-commerce platform a quote number is generated by SAP (ERP) that links all the information associated to the sale to this key number. The critical elements associated to the quote are the client (both its name and ID number) and the purchased SKU (SKU ID, type, quantity).

2. Delivery Programming

A service desk can be found on the main floor of each store. The client must approach the service desk to schedule a delivery order by providing the delivery direction (which be later on used to obtain latitude and longitude coordinates for the delivery), desired delivery date and any limitations regarding delivery window. The service desk clerk will register the delivery order in the delivery planning system using the quote number (SAP is connected to this delivery programming platform, which is an in-house development running on a php platform). Once the province, district and corregimiento (city) is set, the system will assign the specific delivery route zone to the delivery request. The delivery zones has been preset on a database table, by arranging them based on closeness, yet the distribution team has access to create new destinations and associate them a particular delivery zone, as no constraints rules are preset to define this zones.

Then, based on the route zone and product type to be delivered, the system will display the available options for delivery date based on the available request for that particular store at that given moment. Currently, next day delivery is the fastest direct delivery option offered by the organization, but depending on the time the order is received it might not be available for clients (there’s a 12:00 noon cut-off time, although this time may vary depending on the amount of request per day, which normally is around 100-130 deliveries). Furthermore, a daily customer delivery limit of 15 generic and 10 construction delivery requests per route zone for each store has been set; these limits are based on experience as constraints that should account for time and truck size capacity feasibility.

Meanwhile, e-commerce orders have a promise of fulfillment within 24 - 48 hours of the order acceptance, so the delivery programming platform is currently assigning these orders to an specific route zone (regardless of the actual final destination) that does not have a quote limit for delivery requests set yet. Deliveries are not normally scheduled for Sundays, and the construction routes are not habilitated for scheduling for all route zones on all days.

After programming the delivery, a copy of the delivery programmation is handed over to the client along with Home Improvement Retailer's delivery policies for in-store delivery requests and for e-commerce orders, a planned delivery confirmation email is sent to the client's email.

3. Order Approval

Upon recording the orders with their delivery schedule on the delivery programming platform, these records are then transferred to SAP. SAP generates an order request that is sent directly to Infor (WMS). The Client Planner receives these orders and assign them to waves in the WMS. A wave may contain several delivery orders, and although there is not a standard way to generate them, they tend to include orders from the same "Group Code", ach group code representing an specific store. Waves are then approved on the system and warehouse personnel can start picking orders.

In case there is no inventory at the DC nor at the store who completed the sale, the Client Planner export a list from the WMS detailing the affected orders and sends it to the Service Recovery Assistant.

4. Order pick

Once assigned, the picker will receive their picking tasks on their PDT that is running the WMS (Putty access). The WMS arranges the pick task based on the locations of the items, per aisle. A pick to voice system is utilized in the DC, so the pickers do not require hard copies of the pick order.

Once the order is picked, its loaded on a digital container (with an ID barcode) that is reviewed before closing the pick task; after which, the order is checked. Validated orders are then staged near one of the four dispatch bays (17 to 21) at the warehouse "CHILIBRE 2" assigned for client deliveries. Orders are grouped by product type (White goods, generic products, Furniture, Mattresses, and Construction material), with one of the sections completely dedicated for staging all of the product that has been re-collected from the stores for delivery (please refer to section 5.a.i.8). If orders are to be picked-up by the client at the store, then they are moved to the "CHILIBRE 1" warehouse for them to be loaded on the trucks that will be dispatched destined to the stores.

There are physical conditions that limit picking speed; if approved orders haven't been completed, the Client Planner needs to investigate the reason why. For example,

warehouse personnel can only pick from the lower two levels (Zone A and B) of the racks due to equipment limitations; and as height location is not validated currently in the system when approving the order for picking, it could be possible that an additional task for lift truck operators to move products from one level to a lower one needs to be completed before actually picking the products.

5. Delivery Planning

- **Direct-to-Client Orders:**
  Upon receiving the orders with their delivery schedule, these records are transferred to SAP. In turn, when the delivery schedule is generated this information is visible to the Route Planner in the Delivery Planning Platform. Each delivery order has an ID number. The Route Planner filters the delivery orders based on the route zones indicated on the system and groups the delivery orders to be fulfilled by one truck (identified by the plate number) and assigns it on the system. The delivery planning platform is not currently set to account for delivery windows, product mix, volume, nor weight constraints when grouping the delivery requests. Considerations for these constraints is left to the expertise of the Route Planner. Moreover, the Route Planner tries to assign no more than 13 deliveries for generic product routes and 5 deliveries for construction product routes per vehicle as to account in some level for both time feasibility (during delivery) and space limitations in the vehicles. Once these totals are reached, the Planner will assign a second truck (which could be from the retailer's private fleet or one of their suppliers) to the route zone at some point, although this definition is not standardized. If the volume permits it, then route zones can also be mixed, meaning a truck could end up fulfilling orders from route zone 2 and 3.

  Routes are planned to follow an area segmentation for the capital area and for the countryside, with the main routes (as set by neighborhood) being:
  - Route 1: Betania, Pueblo Nuevo
  - Route 2 - Ancón, Albrook, Bellavista
  - Route 3 - San Francisco, Parque Lefevre, Río Abajo
  - Route 4: Chilibre, Las Cumbres, Colon (Nuevo San Juan - Chilibre), San Miguelito.
  - Route 5: Juan Díaz, Crisol, Chepo
  - Route 6: Arraiján, Chorrera
  - Route 7 and 9: Coronado, San Carlos, El Valle.
  - Route 8: Colón
  - Route 33: Web Panamá

- Route 32: Web David
- Route 34: Web Las Tablas

The delivery planner is also going to include in its route for the next day the claims that were already coordinated by the Service Recovery Assistant with the client. This will include both delivery orders that were not fulfilled the prior day and any reposition that they may need to address (i.e. inventory in need of replacement due to nonconformities). For these orders, the Route Planner needs to re-activate any delivery that was not completed throughout the prior day so it can be included in the next-day delivery plan for one of the trucks.

The delivery requests included in one truck will be linked together as the systems assigns a delivery plan ID.

Store collects for deliveries appear on the delivery system and they are associated to its delivery programming ID. Even though a collect has not yet been completed, the delivery planner will include the associated customer delivery in its route. Most of the times, store collects are brought back to the distribution center for consolidation, yet for cases where a store might be located on the same way to the final delivery destination, collects can be scheduled as part of the route for pick-up a the store and direct delivery to the customer.

A route plan is generated on the delivery planning system that details all of the deliveries included in a truck and the sequence to be followed by the driver while delivering on the next day. The new delivery process described in section 5.b. of this report relies on the new route optimization tool to develop the route plan, which is one of the main improvements to the distribution system.

This route plan is then printed and shared with dispatch personnel and the drivers.

- **Store Pick-Up Orders:**
  The gross of the client orders received are directed to the stores. These orders are planned separately from the direct-to-client ones. Client orders to be delivered at the stores are included in the trucks (40 foot) with their replenishment orders as explained in previous sections. They are shipped on a daily basis with orders for clients having priority over replenishment orders from the store. Trucks are loaded to carry products for 1 to 3 different stores. There are 6 routes for these activities in which all branches are included and are divided by region again. Every afternoon the Planner defines what is going to be delivered to the stores based on their

orders, and truck capacity (amount of material by type: floor, cement, roof, etc.), yet this assignment of loads to each truck is based on the Planner expertise. A route plan is then developed in a similar manner as the one detailed before for direct-to-client deliveries that indicates what will be deliver during the day by each truck.

6. Loading

Dispatch personnel separates products based on the assigned trucks for each order as detailed on the route plan. Products are staged by truck during the afternoon / night shift and prior to the beginning of loading operations (around 8:00 am).

Personnel on the night shift arranges the cargo for 4-5 trucks and the cargo for the rest of the trucks are going to be arranged from 6:00 am to 8:00 am next morning.

Loading operations begin at 8:00 am for direct client deliveries. Products are scanned and reduced from the inventory by dispatch personnel. Each digital container is loaded onto a mother container ID that links the order information with the loading dock and vehicle.

The driver is present while the loading is taking place and he may ask to change the loading sequencing of the products based with respect to the sequence on the route plan.

7. Delivery

- **Direct-to-Client Orders:**
  As the vehicle approximates the delivery location, the contact center coordinates a conference call between the client and the vehicle's general helper to get specific details about the delivery address. When the delivery is completed, the client is requested to sign a hard copy of the route plan that serves as proof of delivery (POD).

  The contact center keeps tracks of all events related to non-deliveries in the delivery planning system. These events will generate a new input for the route planning.

  Products that were not able of being delivered during the route are brought back to the distribution center for re-scheduling.

- **Store Pick-Up Orders:**
  For these deliveries the new route planning platform is not used, so there is no satellite monitoring tool; in its place, monitoring is done maintaining constant communication with the driver (mainly text messages) and with the store's warehouse that usually reports at the moment in which the truck was received. When the store receives the inventory, the mother container bar code will be scanned to register the reception of the products at the stores in SAP, which then will generate a delivery report.

  Focusing on the orders that were requested in the store when the sale was completed, as the client attends to pick-up its order at the stores, he is supposed to present the sale's invoice and ID to validate its information and for the store to hand over the products.

8. Inventory Retrieval from Stores (Recovery)

The Service Recovery Assistant looks for the inventory on SAP to identify the store that could fulfill the order the best (in terms of which store has more available inventory and its closer / in the direction of the delivery address). The Recovery Personnel requests for inventory transfers approval to the General Manager. With the approval, Purchasing personnel complete the inventory transfer in SAP and they inform Recovery personnel about the transfer number and the order number for follow-up. Recovery personnel informs the store's warehouse about when the DC will be collecting the inventory, which usually happens between 1-2 days.

9. Claims

Clients can present claims via email or call. Claims associated to non-conformant product identified by the customer should occur during the delivery and as such should be reported to the Contact Center, who in turns needs to record as an event in the delivery planning system. The contact center needs to inform of these cases to the Service Recovery Assistant to coordinate the reposition.

The Service Recovery Assistant contacts Inventory to request for a replacement order, which will be recorded on SAP to be available on WMS for the new processing of this order. Claims resolution target is 1-2 days.

The flowcharts below present a combination of activities and data associated to them that depicts the original delivery planning and execution processes for delivery orders received in the store.

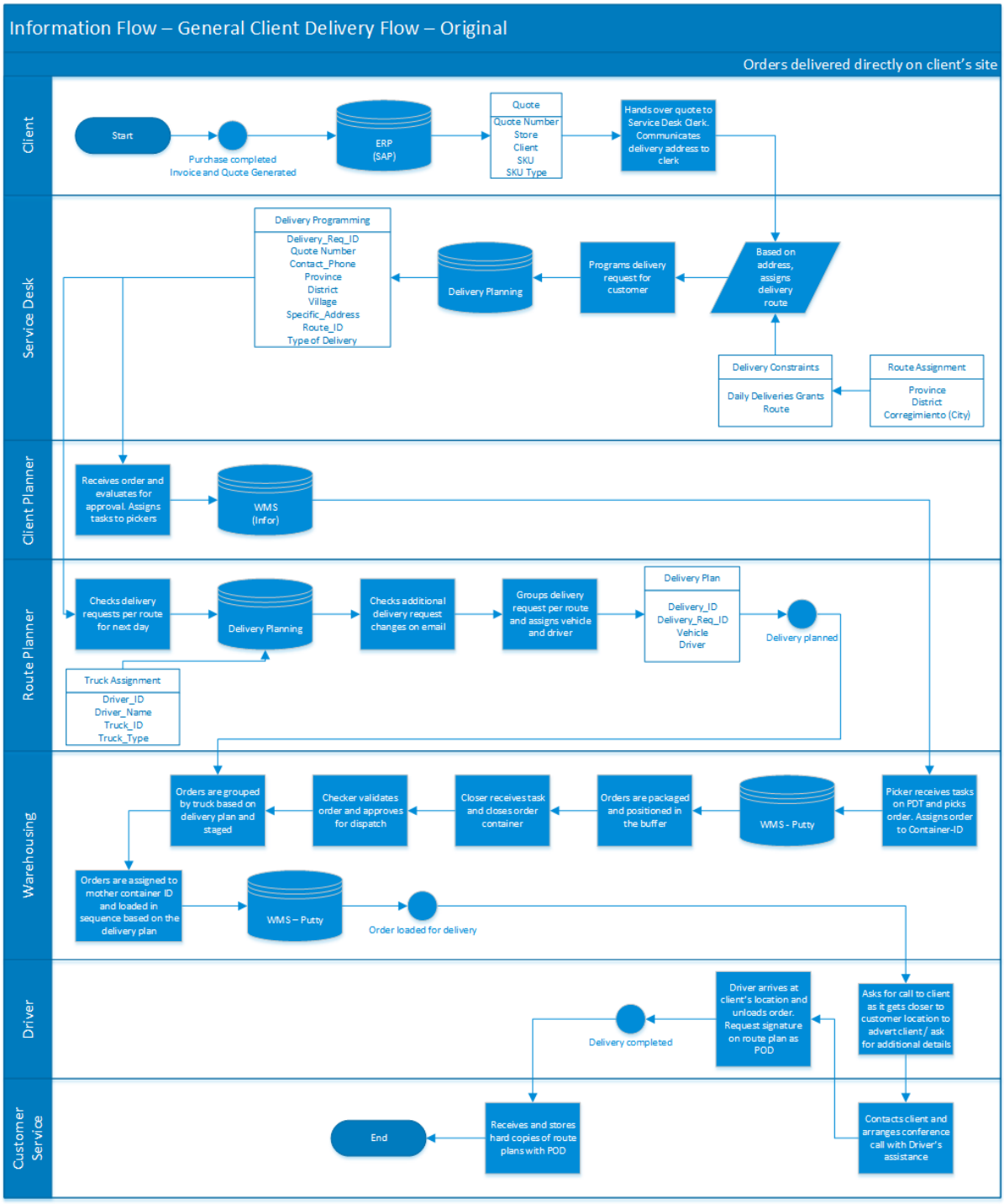

Figure 2. Information Flow – General Delivery Flow for Direct-to-Client Deliveries (In Store Request)

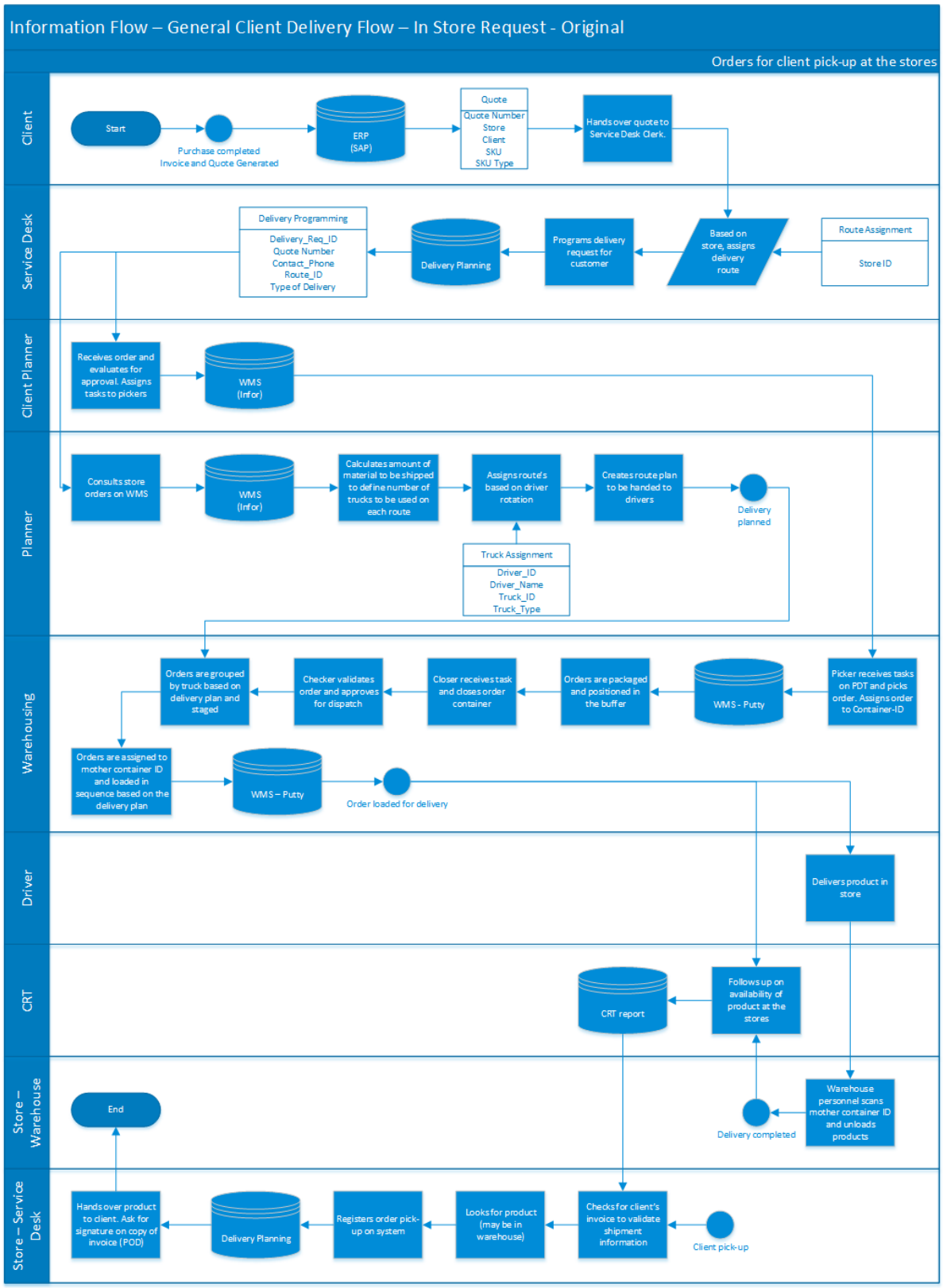

Figure 3. Information Flow – General Delivery Flow for In Store Pickup Deliveries (In Store Request)

ii. Differences for Online Orders

The material described in section 5.a.i describes in great part the flow of information and material for both, in-store and online orders, but the e-commerce channel presents additional considerations for the delivery process for direct-to-client and pick-at-store orders.

The most significant difference is how are the orders received, as now clients will go online and enter "Home Improvement Retailer"'s website. The webpage is built on top of *shopify's* platform. Built-in tools allow *shopify* to keep track of indicators related to the selling process. This platform is connected to the retailer's SAP's to access its inventory information.

Shopify is connected to SAP to obtain the information of the items and the inventory. In the middle of these two, a controller with pre-set rules defined by the e-commerce team determines what items are shown on the website. For example, in order for an article to be shown on the website, it must have full name of the article, photos, description of the article, and price. When it comes to inventory, the company decided to set up a buffer of 3 items, meaning, only sku's with 4 or more units in existence are shown as available for a particular store (and for the website itself) and only one is shown as available online. Currently the client before starting its checkout process can select the specific date in which he or she wishes to receive its order for those items where the selected delivery option was direct delivery. For the items were store pickup was selected, the retailer asks for a two hour wait from the customer, although items could become available faster.

Required inputs from the client after they have made their selection are:

- email
- Customer Name
- Province
- District
- Corregimiento ("City")
- Address
- Phone number

After completing this information, the platform will require the payment information (acceptable payment forms are credit card, direct ACH and *Nequi* (a regional virtual wallet service)) for the order to be confirmed and processed in the following manner:

- **Direct-to-client deliveries:**
  The order is received at the e-commerce office by email (via the shopify platform), with a pre-order number. With this pre-order, the staff issues the fiscal invoice for the complete order (due to local regulation, Panamanian companies are required to issue a physical fiscal invoice that must be handed to the buyer, the retailer must also keep a copy as evidence of the commercial transaction in order to comply with tax regulations). This invoice will be sent using an internal courier to the distribution center to be handed to the client during the delivery along with the warranty information for the items if applicable.

  Two staff members from the e-commerce team are responsible for creating a delivery request in the delivery programming system to schedule the delivery of e-commerce clients, based on the information recorded by the e-commerce platform (meaning the data transfer to the delivery programming system from *shopify* has not yet been digitized).

  With the delivery request programmed in the system, the information will be received by the Route Planner for the DC to program its delivery according to the flow 5.a.i. Once the order has been planned for delivery, the client will receive a confirmation email.

- **Store-Pickup deliveries:**
  Once the order is processed, an email will be received at the store to start preparing the order (hence, the Distribution Center is not aware of any of the online orders under this delivery method). Items will be picked by staff at the stores, packaged if necessary and the commercial invoice will be issued by one of the cashiers and attached to the shipment. Shipments will be then placed by the service desk in the store.

  Once the client approached the service desk asking for an order, the clerk will ask for the client's ID, the order confirmation email, and if applicable, the credit card used for the order to validate that the order information. The service desk clerk will ask the client's signature in a copy of the invoice to keep as proof of delivery (POD).

The flowcharts below represent the basic flow of information and activities for online orders for both direct-to client and store pick-up deliveries.

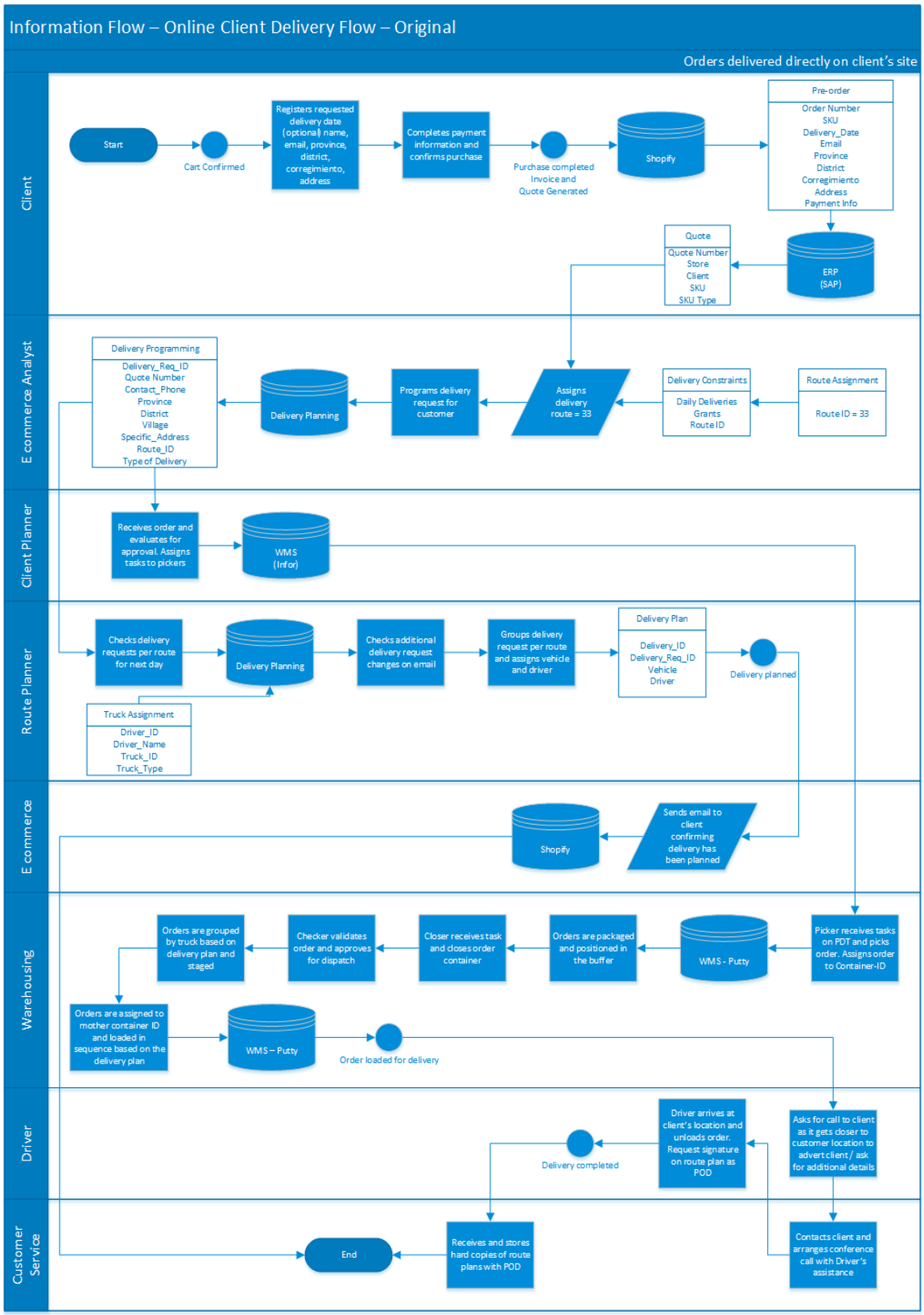

Figure 4. Information Flow – General Delivery Flow for Direct-to-Client Deliveries (Online Request)

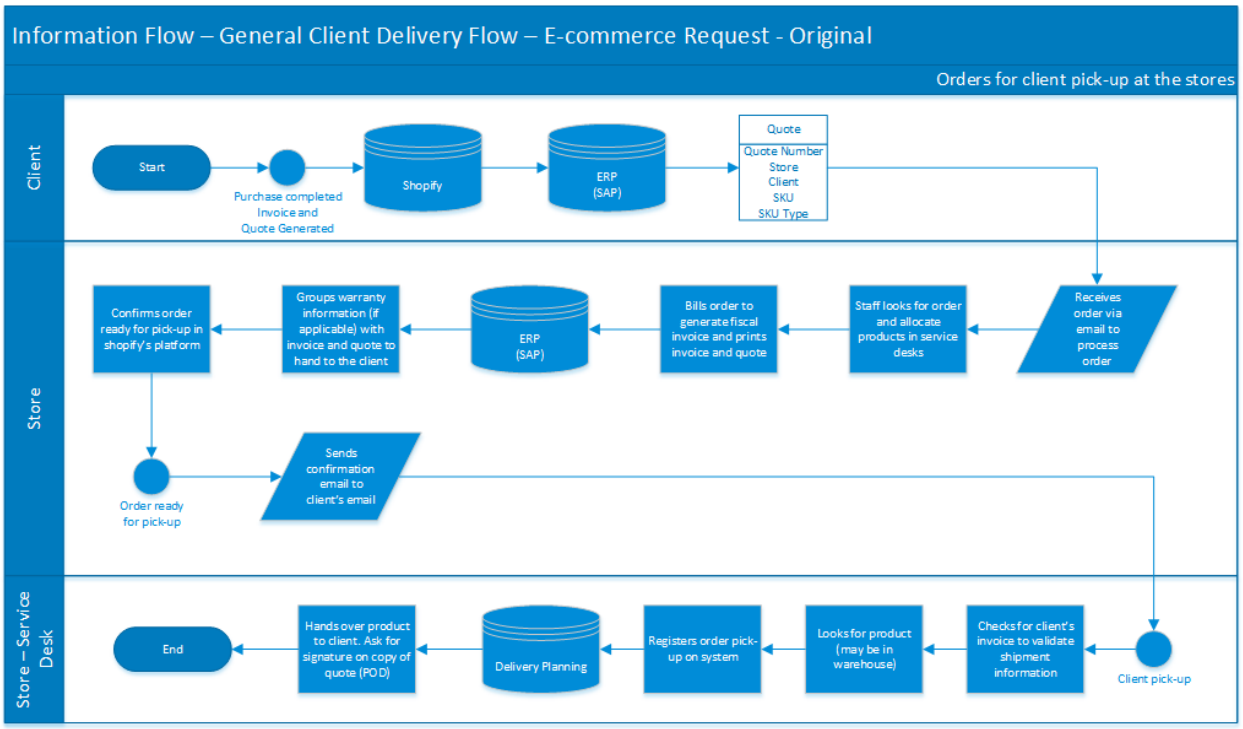

Figure 5. Information Flow – General Delivery Flow for In Store Pickup Deliveries (Online Request)

iii. Information Gaps on Original Delivery Process

The following points presented constraints that limit the effectiveness of the original delivery process from an information flow perspective.

Situation	Issue	Description
Inventory Quantities	Data Quality	The organization is currently undergoing efforts to balance its real and virtual inventory at the DC. Due to its physical characteristics (floor material, ceilings), products kept at the DC is highly sensible to damages while stored, which in turns generates difficulties to balance an inventory.
Picking heights constraints	Information too late	Due to equipment limitations, pickers are only allowed to pick from the two lower heights on the racks. When a picking tasks is assigned, the WMS does not account for product location as one of its deciding factors.

Lack of dimensions and weights for SKUs	Lack of Information / Data Quality	The item dimensions are not yet completely registered in the WMS to fully guaranteed the correct working of volume capacity constraints of the fleet, as well as compliance with local regulation about trucks' weight.
Lack of product mix constraints	Unable to make use of information	The route planner tries to account for product type (generic or construction) in an effort to not mix them, yet the delivery planning platform does not account for this combination when setting the route plans.
Coordinates for Deliveries	Lack of Information / Data Quality	Under the original delivery process, coordinates where not accounted for when planning routes, which limited the effectivity of the sequencing of deliveries. With no specific coordinates for deliveries, the sequencing of a route ended being a fairly variable definition.
Visibility over on route conditions	Lack of Information / Information Lateness	Vehicle tracking was limited to location reports exchanged via calls or text between the DC and the driver (or its general helper) during the route, yet the exact location of the vehicle was nearly impossible to validate. As live position was not completely available it wasn't possible to take decisions to modified routes as changes in traffic, accidents, and similar presented themselves during transit.
Visibility over real route sequence and delivery completion time	Lack of Information	As drivers change the sequence of delivery versus the one established in the route plan, the actual delivery sequence and delivery time is not been recorded to be later on utilized as an additional input for delivery planning.
Lack of standardization in customer's specific address	Too many forms of information	Routing initiatives depend greatly on customers location, which could present an issue due to lack of standard addressing in Panama and early

		adoption of geocoding systems may tampered with location accuracy.
Adjustments and recording real address / additional details for location	Lack of Information / Unable to make use of information	Changes in the specific location of the delivery might not be registered back into the data systems. Even though communication with the client prior the delivery is generating additional details about the specific location, this data doesn't appear to be registered back into the system in the form of usable data (coordinates, or any similar).

b. Current Delivery Process - General Description

As "Home Improvement Retailer" goes through the implementation of their new delivery planning platform, a pilot program was developed to test out some of the capacities of the new Delivery planning "Software X" with a sample of the available fleet.

The new Delivery planning "Software X"-based activities were added to the general route planning and execution flow of six trucks, impacting mainly three components as detailed in the following table:

Component	Summary of New Capacities
Route Sequencing	For each preset load plan of a truck, the new Delivery planning "Software X"- was to be used to help in optimizing the stops' sequence, based on the time available for the deliveries. The definition of the stops sequence takes into consideration historical traffic data from Google Maps and the delivery windows of each delivery request, although this last element was set to 8:00 am to 5:00 pm for all deliveries.
Route Visibility	The mobile app that is accessible to the drivers is the enabler of the deliveries' visibility. Tracking the GPS from the driver's phones and recording tasks as they are started and completed on the app allows for tracking, status updates, exception management and estimated times of arrival availability in this new version of the delivery process.

Route Performance Metrics Availability	Once again, the tracking and recording of tasks on the app also creates the possibility to have an easier and faster access to delivery performance information including toured distance, fulfilled deliveries, on time deliveries, partial deliveries, deliveries not completed, stop time, usage time for trucks, among others.

To facilitate these new capacities, as introduced before, new tasks and data were added (or slightly modified due to new resources) to the original information and process flow for deliveries depicted in the next flow diagram. As the new routing and monitoring tool impacts direct-to-client deliveries we are focusing our analysis in this case. New elements from those exposed in the flow presented at the end of section 5.a.i. have been marked in red.

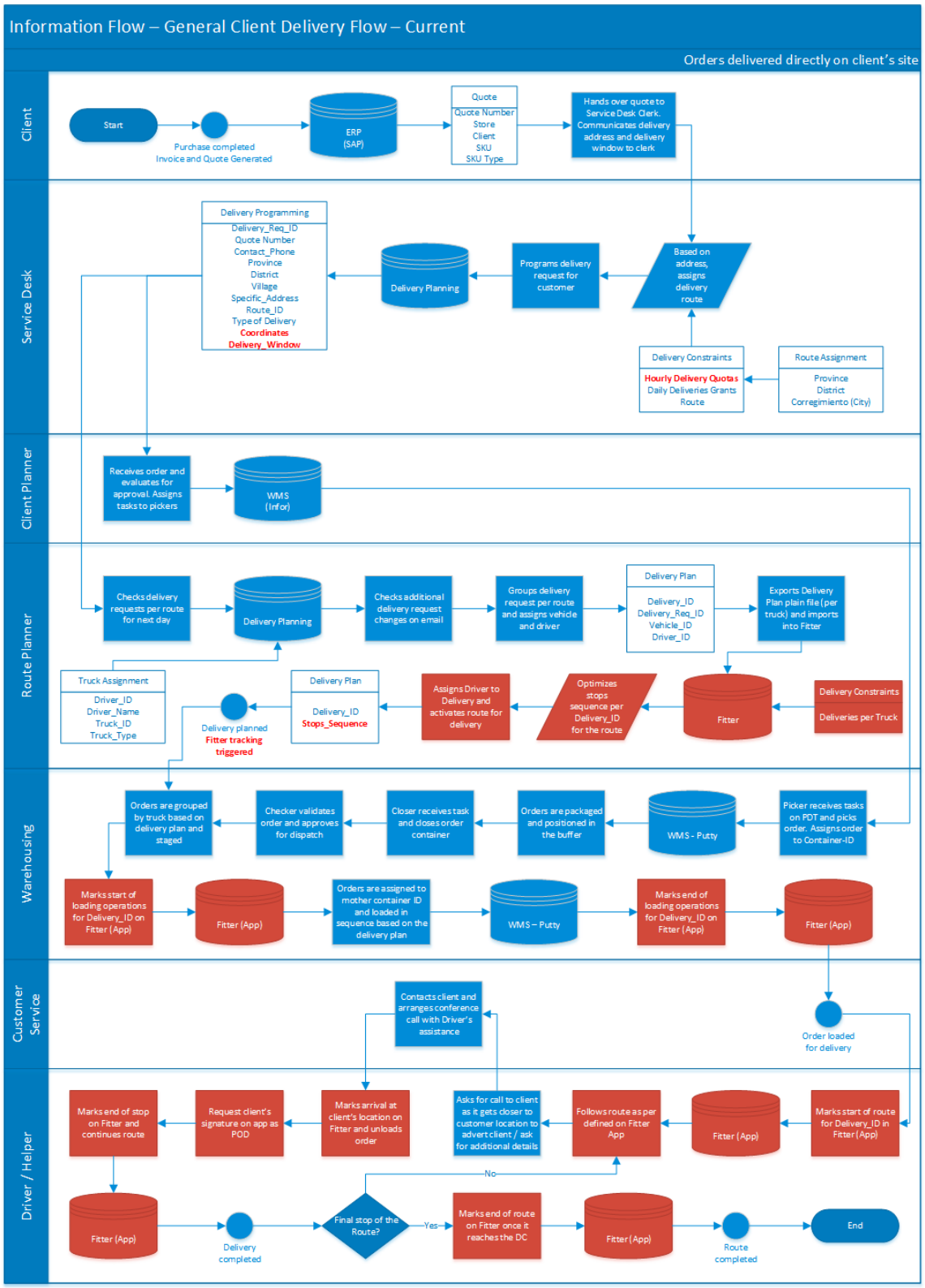

Figure 6. Information Flow – Current Delivery Flow for Direct-to-Client Deliveries

When comparing the current workflow with the original one it is clear that the new capacities of the delivery process have come to the expense of added-complexity within the same underlying process (delivery programming, delivery planning, order picking, dispatch, and final delivery) although there's still efficiencies to be gained from the further integration of their in-house Delivery Programming Platform and the new Delivery planning "Software X".

i. New data required on the current delivery information and process flow.

The new tasks associated with this new version of the process still require additional information to sustain the process, provided truck and driver information (both type and ID have been) already share among the two systems:

- **Delivery coordinates:** While the delivery is been programmed with the service desk, the clerk will need to request for the specific delivery address (on top of the more standard province, district, and city). With this information, the system is taking advantage of a Google API to show a specific location on an on-screen map that must be validated with the client. As this specific location is set, the API will insert the coordinates from google map onto the planning system.

- **Delivery Windows:** As "Home Improvement Retailer" aims to offer a better customer service; a specific delivery window will be asked to the client. Although not clearly yet defined, the organization is planning to set one-hour delivery windows as part of their service offerings. The delivery sequence for a route will be defined using the delivery coordinates on the new Delivery planning "Software X" as the optimization model tries to find the optimal route based on traffic history around the delivery area and the required delivery window.

- **Hourly Delivery Quotas:** In order to eliminate possibilities for non-feasibility within the routing model a maximum number of deliveries per route will be set for each route and for each of the possible delivery windows. This constraint will be set on the Delivery Programming Platform. The organization is targeting to establish an hourly delivery maximum quota between two and three deliveries, which is an estimation based on the average time spend moving from one stop to the other and completing the delivery has been (estimated between 15 and 20 minutes).

ii. Detail on changes of the current delivery process versus the original state

The current delivery process takes advantage of the newer data described on section 5.b.i. in the following tasks:

- **Driver assignment and route creation:** Under the current process the delivery plan created on the delivery planning platform is exported as a plain file and loaded into the new routing and monitoring platform . The driver (and truck) is manually assigned by the Planner still.
- **Optimizes sequence of deliveries:** based on an optimization model that now accounts for delivery windows and traffic history around the geolocation of the delivery. Orders have been pre-assigned to a specific truck previous to inputting the data for each delivery.
- **Tracking of start and end of loading operations:** Loading is set as the first milestone for each delivery on the new Delivery planning “Software X”. With each daily route now loaded in the system, the start and end of loading for each truck is recorded on the app by the Dispatch Assistance in real time. The ETA for the deliveries could be recalculated after marking the end of the delivery.
- **Inputting start and end of route, as well as start and end of visit at each stop:** The drivers will mark on the the new Delivery planning “Software X” app the start and end of the route, as well as the visits to keep track of service time. ETAs are also recalculated by using this data. In case the drivers forget to record these milestones, the app will track the GPS for during the route and estimate the visits duration based on the location of the truck.
- **ETA update:** Alerts will be sent to the distribution team (and eventually to the client) based on the route progress in the case delivery windows are not going to be met. This is especially applicable in those cases where the driver may not follow the route as planned in the app.
- **Electronic PODs:** PODs will be stored digitally now, as the new platform allows records the signature of the client on screen now. This functionally could generate savings in time invested looking for physical copies of PODs when claims are presented.

iii. Information gaps and other considerations affecting the current delivery process

As it was presented on section 5.a.iii. this new process also must deal with most of the same information gaps, although the additional elements involved in its execution (google API for coordinates, route optimization model, and vehicle visibility and tracking) are providing tools to mitigate concerns over coordinates for deliveries and visibility over route conditions, stops sequencing, and delivery completion time. Yet, other considerations arise from this new process:

1. Lack of back and cross registering data between systems

Due to missing data a lot of information is manually inputted into The new Delivery planning “Software X”, via plain files, yet data is not currently been registered back to SAP, nor the Delivery Planning Platform. As The new Delivery planning “Software X” data is currently been store within itself, there could be benefits generated from back and cross registering data used in The new Delivery planning “Software X” for the rest of systems in Home Improvement Retailer’s digital suite. For example, the coordinates where the delivery was actually made could be recorded, registered in the Delivery Planning System and then used if applicable when the same client orders a new delivery request for that address.

2. Standardization and data cleaning of SKU related details

While product mix constraints have been observed as part of the on-site analysis of the route planning process, while revising the historic data for last year deliveries, it was noted that some delivery plans included construction products and generic products on the same vehicle. Although this constraint can be relaxed smartly under a manual process performed by an experienced planner who understands when the mix of generic and construction products is possible without quality implications. Currently all the SKU’s are categorized as construction or generic type, but other data labels may need to be added to properly define which products can be mixed in the same container.

Other input to be defined clearly are product units. Beyond the correct registry of item’s dimensions and weights in the system, if container size and volume capacity for trucks and platform are to be taken into account for the delivery grouping within the same vehicle, there will be a need to define how to handle products with quantities measured continuously (in volume or length units) versus those who are measured discreetly (in eaches).

3. Coordinates recording compliance

Lack of direction standardization has been already explained in previous sections. It is critical to take advantage of the client's input to correctly define the coordinates for the delivery when programming the delivery on the service desk, as the google API is in place to insert the coordinates for the specified delivery point in the delivery request record. If this task is not completed in this step, the delivery coordinates will need to set further along in the process where direct access to the client is not available as easily, which only augments the importance of process compliance at the service desk, especially taking into account that the delivery requests records show that a third (out of 4711 delivery request) of the direct-to-client delivery programmed between May 1st and June 24th, 2019 did not included delivery coordinates.

Intervention from an associate and the client will remain necessary on both scenarios because, as imagined, relying on the effectiveness of google APIs alone (please refer to annex 1), can present additional difficulties. In order to study this phenomenon, we generated a basic python code that’s connected to google maps and checked for the coordinates associated to the specific address for a subset (including over 5700 deliveries programmations) registered in the delivery programmation system. In the image below, we have graphed in blue the coordinates associated to each shipment by using the latitude and longitude from the delivery request records with most of them clearly identified around Panama. Yet, it is not possible to identified how many of these coordinates were obtained without the intervention of a human.

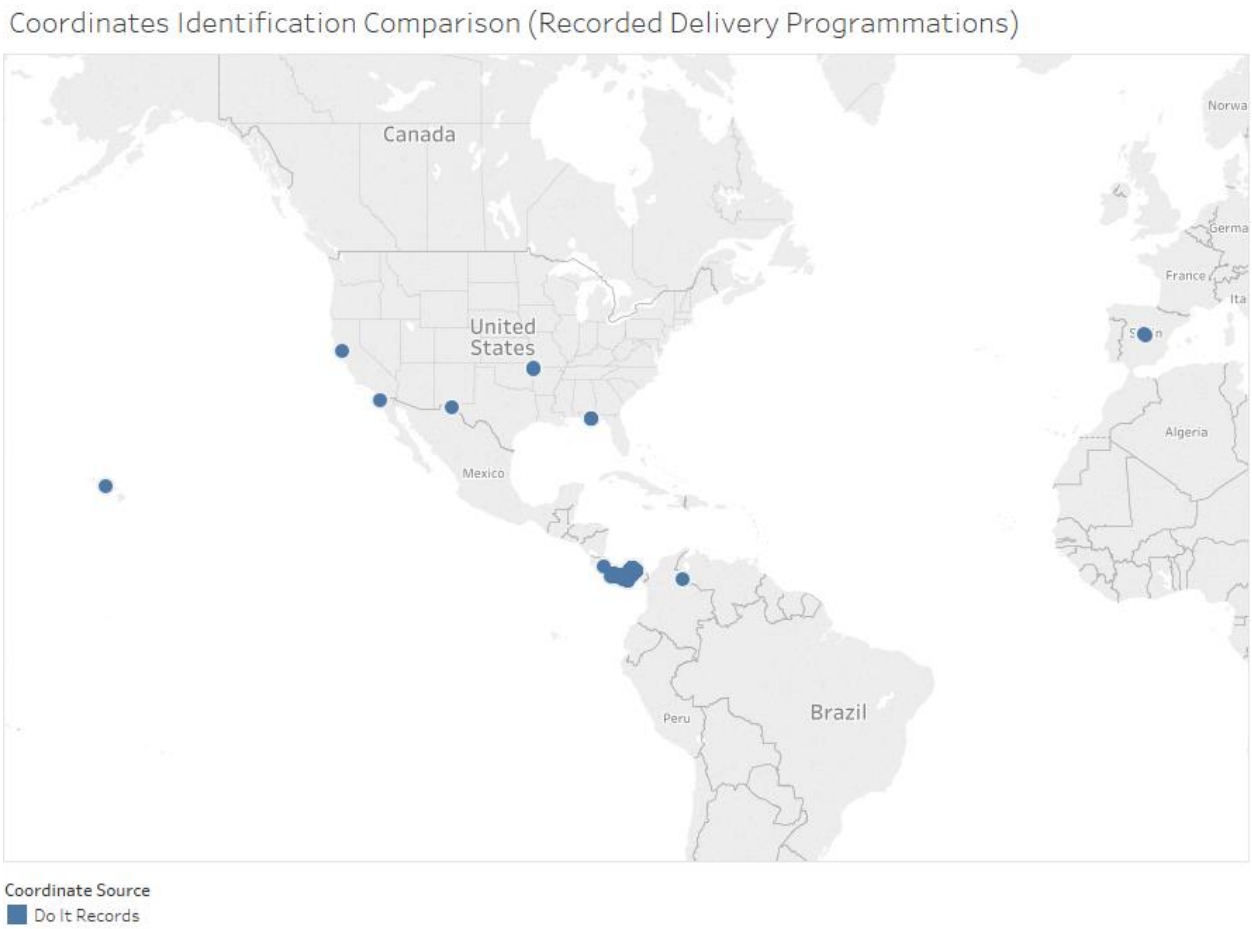

Figure 7. Locations for Historic Deliveries based in Recorded Latitude and Longitude

There's still some significant difference in the locations, even if we focus only on those who were properly identified within Panama. By restricting our findings to only Panama, the code can find the locations for over 5,700 delivery locations based on address records from the received data, pairing over 2,600 that are compared on the pictures below. On the left, image 8 includes the locations records from Home Improvement Retailer programmed deliveries and on the right, the locations identified via our python code.

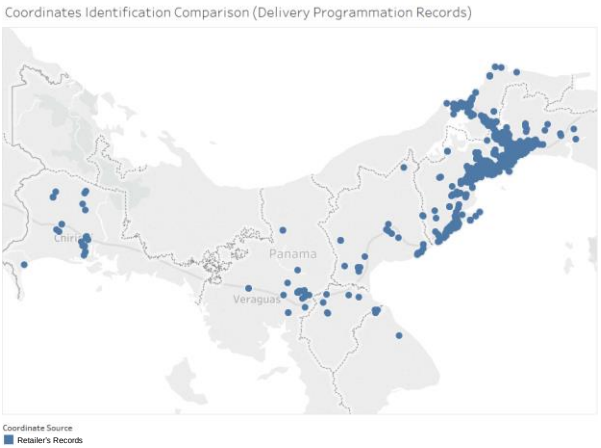

Figure 8. Locations for Planned Delivery Sites (Actual Data)

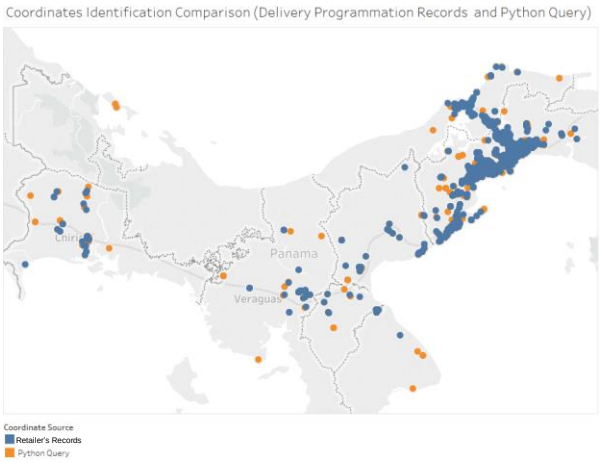

Figure 9. Comparison for Planned Delivery Sites Records and Delivery Site Identified Through Google's API

Among those coordinates who were correctly located, the difference in distance between the location identified through our python code and the location recorded in the delivery programming database is 6.26 km in average[3] (with results ranging from less than one meter to 811 km).

Yet, the google API appears to be have an easier job identifying locations of buildings than of houses, although making an assessment presents its difficulties as this is not a clearly identified label within the records. A rough segmentation of the data looking for addresses containing horizontal property built as part of the specific address field allow us to estimate an average separation of 2.47 km between coordinates identified on the database and those identified with our code. Yet, the effectiveness of the queries still remains significant with results ranging from less than one meter to +180 km, as can be seen below:

[3] This average ignores a subset of 10 coordinates originally identified in the delivery programming database with geographies outside of Panama.

Figure 10. Planned Delivery Location of a Building with Great Accuracy Identified through Google's API

Figure 11. Planned Delivery Location of a Building with Bad Accuracy Identified through Google's API

Restrictions could also severely affect the results of the google API. After generating an additional subset of programmed delivery points (for just one day of deliveries) and running them through our python generated google API, now with no restrictions with regards to country associated to the coordinates, we can further understand the importance of human intervention in identifying the location of the delivery, as now the orange dots (representing the coordinates obtained through the python code) help us visualize in the image below five shipments outside of the country.

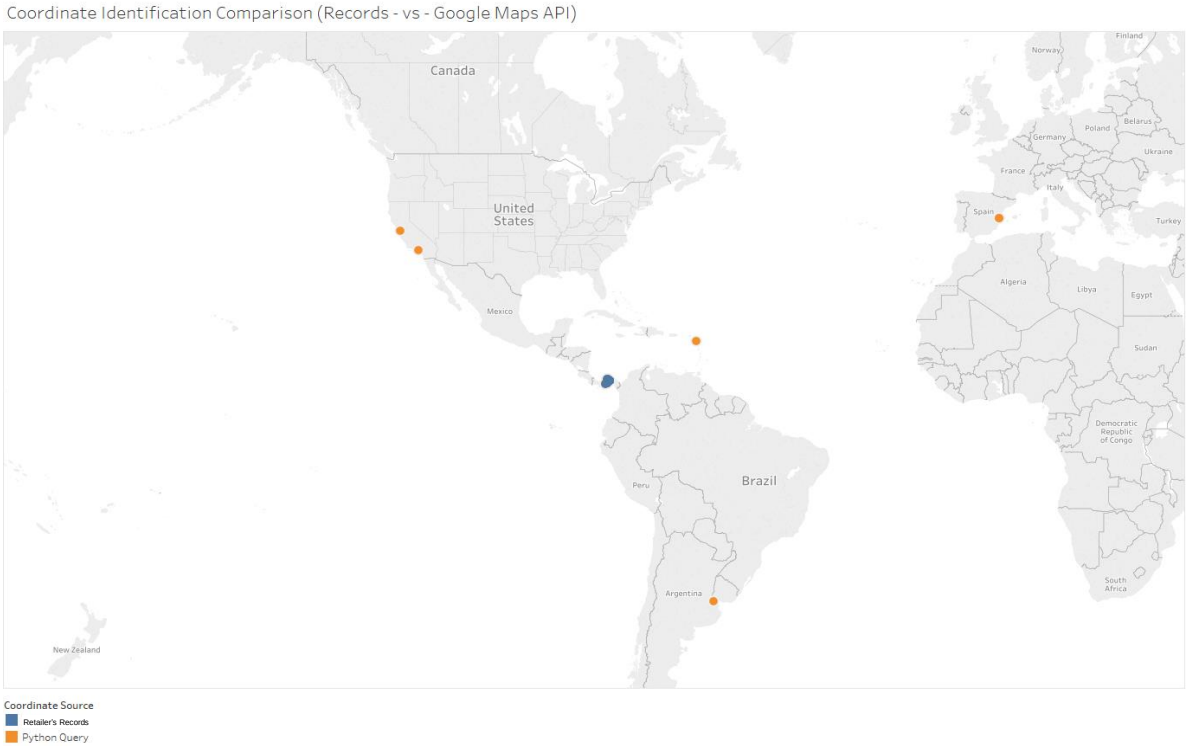

Figure 12. Coordinate Identification Comparison Between Planned Delivery Records and Google's API Locations

To expand on the exercise and tried to prove the same geolocating accuracy, we identified 21 new addresses in Panama City containing records for commercial and residential addresses and obtained their exact coordinates, After running the addresses through our google geolocation API python code we reached the same underlying conclusions for the 19 successful pairings; Google's geolocation API does a far better job geolocating addresses for commercial locals and buildings (for which our python obtained coordinates were off by 115 m in average) than for residential houses (our python obtained coordinates were off by +2 km in average).

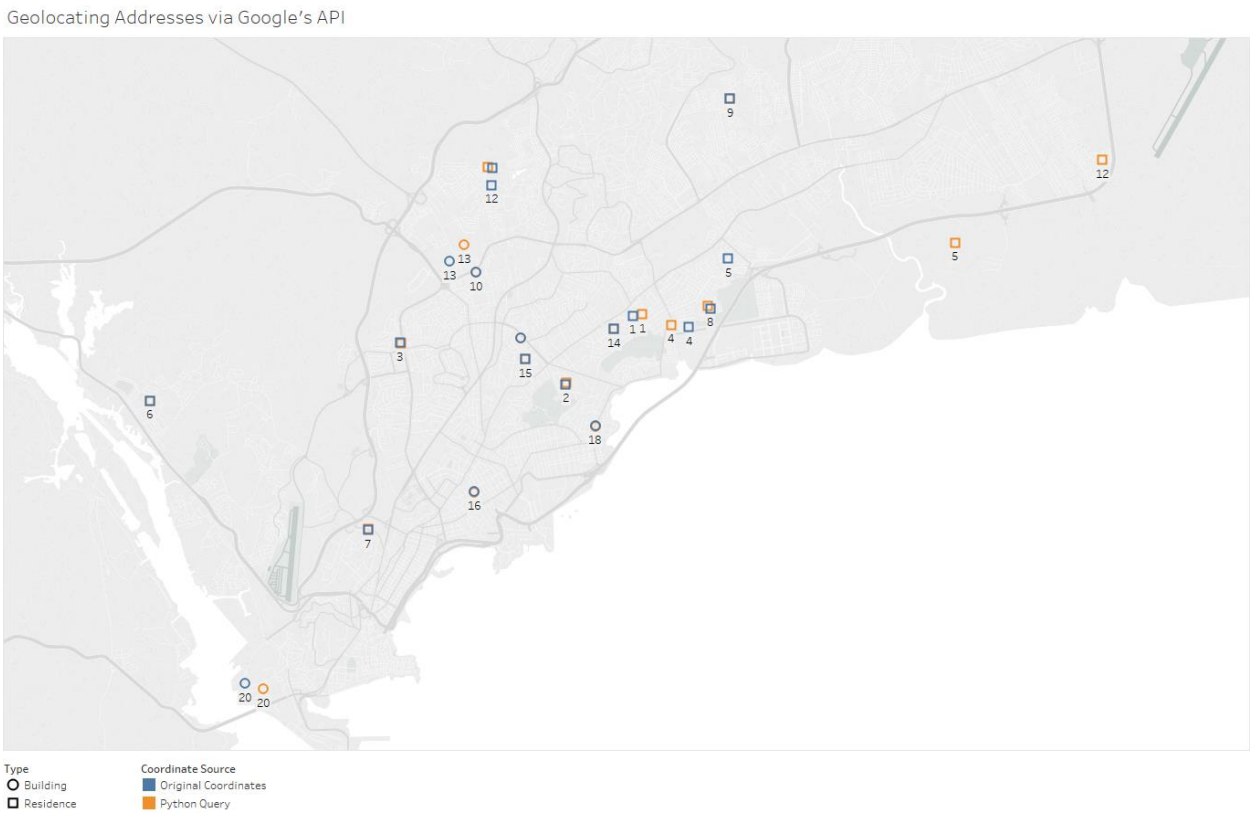

Figure 13. Geolocating Exercise Results for Additional Locations in Panama (Not Retailer's Records)

Table 3. Geolocating Exercise Results for Additional Locations in Panama (Not Retailer's Records)

Address Type	Sample Size	Average Distance between locations (km)
Comercial	7	0.074

House	5	0.022
Building	2	0.203
Residencial	**12**	**1.548**
House	8	2.262
Building	4	0.119
Grand Total	**19**	**1.005**

This exercise takes special importance for the online channel, where manual adjustments for the location of the delivery point are done without the presence of the client when programming the delivery, as the e-commerce platform has a built-in tool that locates the coordinates based on the typed-in address, but ultimately relies in e-commerce personnel for programming the delivery in a similar manner as the in-store delivery request.

4. Stops sequence and in-app route milestone recording compliance

Driver buy-in is needed to ensure the success of the delivery tracking app. Stops sequence will need to be followed as defined by The new Delivery planning “Software X” during the route planning phase of the process (especially after defining a tighter delivery window for each delivery) and later on during the actual execution of the deliveries (for more details about this, please refer to point 4 of this section), which could present challenges as drivers have grown accustomed to defining their own stops sequence for its daily route.

Moreover, the driver usage of the app is the key enabler of all visibility functionalities for The new Delivery planning “Software X”, as well as it reporting tools. Drivers will need to make sure to log stop arrivals and departures while completing the deliveries to feed propper data to the system. These data logs will generate additional inputs that could affect the delivery offering constraints defined in the delivery programming platform as more reliable data on traffic and average time spend on stops becomes available to add robustness to the definition of maximum deliveries per route per delivery window.

On the cost site, the proper route definition will likely influence the reduction of fuel costs, which then again, will be more attainable if an optimal route is followed instead of a manually defined one.

5. Actionability over on-route events

Live tracking of the trucks locations and feedback on the route plan state will allow for opportune decision making to address missed delivery windows. Additionally, the event log for each delivery could be used to expedite reprogramming activities when for some reason deliveries were not completed (regardless of the cause of this).

Even though, The new Delivery planning "Software X" sends alert emails to the Route Planner (and is capable of sending them to the client as well) when these events occur, "Home Improvement Retailer" will need to capitalize on the value of this information to mitigate impacts to customer satisfaction and take advantage of it to use its distribution network in a smart manner.

The current contact center could evolve into a control tower central with enough empowerment to make decisions that impact the delivery process on an operational level, including, but not limited to:

- Reprogramming deliveries
- Driver - DC delivery sharing instructions
- Trigger inventory retrieval from stores and between stores.
- Customer contact and data logging.

c. Additional concerns over digitalization of the delivery planning process

- **Security:** Crimes against economic patrimony account for over 40% of all crime reports in Panama according to the Accusatory Criminal System (SPA in spanish)[4]. Additional constraints may need to set within the route programming to limit the probability of trucks being around dangerous zone at certain hours that have not yet been defined in the delivery programming platform, nor in The new Delivery planning "Software X".

[4] Accusatory Criminal System (SPA). Panama. Statistics available on: http://ministeriopublico.gob.pa/estadisticas-judiciales/estadisticas-sistema-penal-acusatorio/

- **Rural environment:** Panama's main market is located around the metropolitan area that surrounds the capital city. Route planning for this area is affected mainly for traffic congestion during peak times, yet, it is clear that a non dismissible percentage of population is located around rural areas. The world bank reports that 32% of Panama's population is located around rural areas[5], which other than limited due to infrastructure, present challenges due to data coverage and greater distance between route stops that could limit the amount of available slots for deliveries defined in the delivery programming platform.

- **Payment Collection:** All deliveries (with the exception of some credit clients) are coordinates on a prepaid basis. For "Home Improvement Retailer" due to low credit card adoption in the country, this has lead to including additional payment option on their website (in addition to credit cards you can pay using saving accounts and a regional mobile wallet). In addition to changing the way they use their existing cards, consumers are also increasingly reliant on non-card forms of payment. The ongoing surgance of new non-card payment models, particularly via mobile phones adds a new layer to consider when adapting the organization's marketplace environment, as there the potential of disposing of traditional card-based payment methods increases.

- **Billing and warranty documents:** Due to local legislation, every direct-to-customer online shipment needs to be accompanied with a physical fiscal invoice, which needs to be generated from a fiscal printer. Current process has this task being performed in "Home Improvement Retailer" headquarters on a daily basis firms where the fiscal invoices are generated and later on sent to their Distribution Center to be added to every shipment along with the warranty documents for the item. Other than changing the location or adding a new fiscal printer in the Distribution Center to avoid the travel, this task will need to continue to be performed until legislation evolves to allow for digital invoicing.

6. Value of the Solution

The aim of this section is to provide a path to measure the improvement of the distribution system as a whole with the added capabilities of The new Delivery planning "Software X". Digitizing the delivery planning process will generate better customer service, it will

[5] World Bank staff estimates based on the United Nations Population Division's World Urbanization Prospects: 2018 Revision. World Bank. Data available on: https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?end=2018&start=1960&view=chart

reduced workload for distribution personnel, and reduced cost for the distribution system, as detailed below:

a. Improvements in customer service

i. Increase delivery transparency

Timeliness of delivery has a direct impact on customer satisfaction. On this sense, The new Delivery planning "Software X", with its mobile platform provides automated real-time track and trace, providing shipment (and driver) information to the distribution personnel via alert emails. Information related to location and ETA will eventually be shared with customers (currently, the sponsors technology team is working with the new Delivery planning "Software X"'s team to develop an API to take advantage of the new Delivery planning "Software X"'s alerts and communicate them to the clients via the current delivery programming platform). Customers will monitor their expected shipments and receive proactive alerts. The result of better monitoring conditions could also generate additional benefits for the retailer in the form of time and cost savings for the distribution team (as it will be explained in section 6.b and 6.c.i).

ii. Reduce missed deliveries due to miss delivery windows and incidences response time improvement.

The sponsor currently keeps tracks of deliveries that were not able to be delivered because of missed delivery windows, which account for around 1% of direct-to-client deliveries (for the period between June 2018 and June 2019). However, there are no records to analyze missed delivery windows as a general exercise, as the client could have still accepted an order outside of its required timeframe, nor how many of the deliveries that were rejected happened after the trip to the delivery site or before it (meaning the truck avoided costs and time associated to travel to that specific site).

Transparency and accuracy over delivery ETA and how this compares to required delivery windows generates the possibility to think about alternative options on the best way to fulfill an order (especially those that may have become affected due to unexpected conditions while on route). If another vehicle can be used to satisfy the order on time, given that there is inventory available (both in the DC or in a different store), the order could still be satisfied on time if the DC receives the lateness alert with enough of a time buffer to prepare and additional shipment.

b. Reduced workload

i. Reduced workload for Route Planner

One of the most labor-intensive positions within the distribution team is the Route Planner. After a few work sessions accompanying the Route Planner while executing her tasks, it takes this person between 4 and 6 hours to plan the routes for next days deliveries, from which about 70% of it is devoted to the critical task of grouping and balancing the amount of deliveries among the available fleet (both internal and outsourced) with a daily set that usually accommodates routes in 12 trucks, 3 platforms and 2 vans, while taking in consideration constraints (weight, volume, any expressed delivery window, unload elevator availability). If we focus on the Route Planner who's responsible for the routes planned within the Metropolitan Region (Panama, Colon, and Web Deliveries), there's an estimated savings of almost 880 yearly hours detailed below. In order to fully achieve these savings the new Delivery planning "Software X" will need to be set with truck size constraints (and SKU dimensions), as well as the delivery windows:

Table 4. Estimated Savings From Route Planner Workload

Detail	Amount[6]
Total Direct-to-Client Vehicles Dispatched (June 1st 2018 - June 24th, 2019)	5125
Estimated Route Planning Workload (Estimating 5 hours daily for 14 (statistical mode) vehicles)	1,464.29 - 2,196.43
Estimated Workload due to shipment grouping and balancing (60% of total workload)	1,025.00 - 1,537.50
Average Working Days per year	286
Estimated Yearly Workload Savings (Hours - Route Planner)	**821.15 - 1,231.72.44**
Estimated Monthly Salary	$ 721.00

[6] Lower estimates done with base in 4 hours of work, while upper estimates account for 6 hours of worktime

Monthly Mandatory Taxes, Vacations and Bonus per Panamanian Regulation (45%)	$ 389.34
Estimated Yearly Manpower Savings (Cost - Route Planner)	**$ 4,502.46 - $ 6,753.69**

ii. Reduced workload for Contact Center

As seen from the call reports, the contact center right now accounts for about 526.5 ± 90 (lognormally distributed, for an statistical analysis on calls data, please refer to annex 2) outgoing calls with each of them lasting about 1 minute and 11 seconds (not taking into considerations deliveries on Sundays). Yet average daily direct-to-client daily deliveries is 101 ± 35 (once again, not taking into considerations deliveries on Sundays), which suggests a significant amount of calls are follow-up calls with the drivers.

When completely implemented, the new Delivery planning "Software X" will likely reduce follow-up calls by providing a better alert system to both DC and clients, and a monitoring tool for trucks locations during their routes. The estimation in call's reduction could be further increased if the system relies in better geocoded delivery locations, as clearer instructions for the delivery.

By considering that calls can be reduced to at least two calls per delivery (to contact the driver and generate an address validation conference with the client, which in due time could also be further reduced as the retailer collects more information about specific coordinates for each client's address) an estimated 2,076 hours could be saved yearly as calculated below. Customer behavior information is hard to predict, as such only the outgoing calls have been taken into account for this savings calculation:

Table 5. Estimated Savings from Contact Center Workload

Detail	Amount[7]
Average Quantity of Deliveries per Day	101 - 184
Estimated Total Calls per Day	526 - 734

[7] Upper estimations account for 99% of the standard deviation of daily calls and daily deliveries data

Estimated Calls per Hour	50
Estimated Duration per Call (Minutes)	1.19
Effective Daily Delivery Calls	202 - 368
Average Working Days per year	286
Estimated Yearly Workload Savings (Hours - Contact Center)	**1,837.84 - 2,076.07**
Estimated Monthly Salary	$ 721.00
Monthly Mandatory Taxes, Vacations and Bonus (45%)	$ 324.45
Estimated Yearly Manpower Savings (Cost - Contact Center)	**$ 10,077.09 - $ 11,383.38**

c. Reduced Cost

i. Cost associated to missed deliveries

Building on the two previous points, the assessment of missed deliveries shows that the rate of missed deliveries to direct-to-client deliveries is 7.6%. By analyzing the recorded reason of missed deliveries, we have estimated that the new routing platform could potentially reduce over 60% of them (there were over 2,600 missed deliveries in the period between June 1st, 2018 and June 24th, 2019).

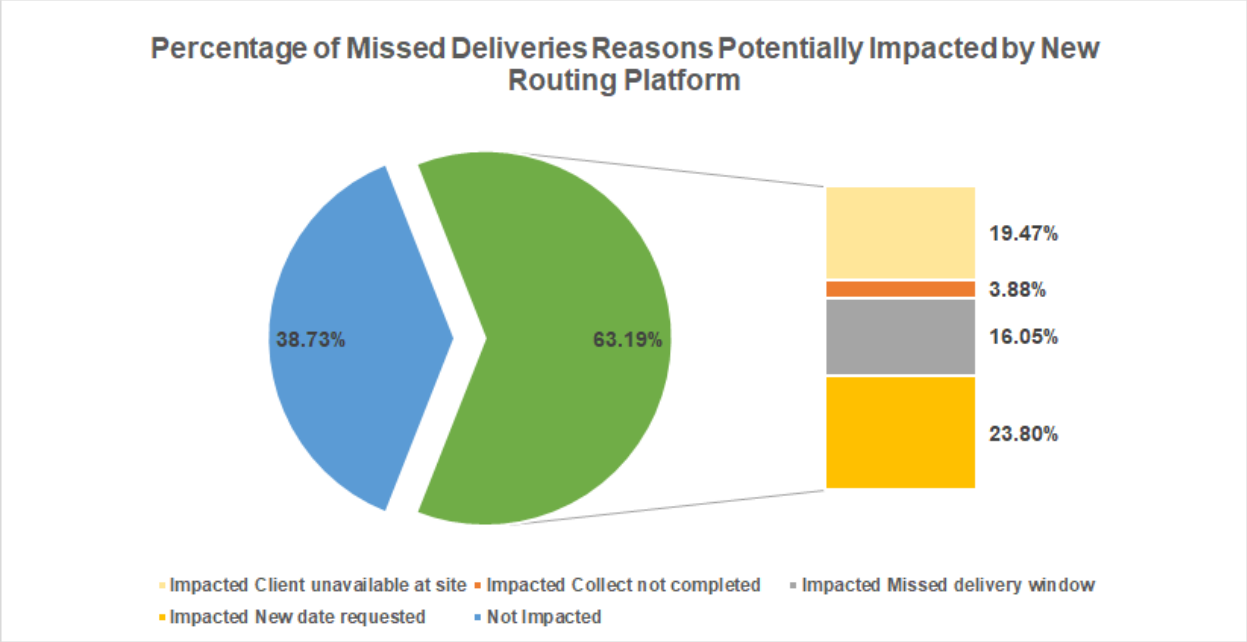

Figure 14. Percentage of Missed Deliveries Associated to Reasons Potentially Impacted by the New Routing and Monitoring Platform

There's a percentage of the estimated costs per delivery that could be saved due to these non-productive trips. Given that the estimated cost per delivery is equal to $16.51, which means that yearly costs associated with missed deliveries could total $40,893.95 (delivery cost associated to 2,633 missed deliveries in a period of 388 calendar days and then adjusting this value to a yearly amount). The detailed calculation is included below:

Table 6. Estimated Yearly Costs due to Missed Deliveries

Detail	Estimated Cost
Daily ManPower Cost Driver (45% cost adjustments due to taxes, vacations and mandatory bonuses)	$ 37.72
Daily ManPower Cost General Helper (45% cost adjustments due to taxes, vacations and mandatory bonuses)	$ 34.98
Daily ManPower Cost Route Planner (45% cost adjustments due to taxes, vacations and mandatory bonuses)	$ 43.87
Daily Estimated Fuel Cost	$ 25.00

Yearly Insurance Cost per Car	$ 1,200.00
Yearly Maintenance and Consumables Cost per Vehicle	$ 800.00
Estimated Working Days per Year	286
Weighted Average for Daily Deliveries per Truck	9
Estimated Cost per Delivery	**$ 16.51**
Missed Deliveries (Between June 1st, 2018 and June 24th, 2019)	2,633
Estimated Costs Due to Missed Deliveries (Adjusted to Yearly Calendar)	**$40,893.95**

Optimized routes should have a direct impact on missed delivery windows, but thanks to increased delivery planning information transparency with the client, non-productive trips (trips that ended up in undelivered orders) could potentially be reduced also.

Given that the new routing and monitoring system provides timely information for the decision making of the DC, a percentage of these costs could be cut down under better event management associated to missed delivery causes which will greatly depend on the availability of real-time alerts about ETA and changes as the route progresses, and how close are the planned estimates for service time at each stop versus the real time taken at these. By providing information to the client about its ETA once the route has been initially planned, and updating it as the truck follow its route, the client has a final checking point as to when is his or her order going to be delivered, and if necessary, could ask for changes to it in collaboration with the distribution team.

ii. Fuel and consumable expenses:

The routing system now allows easier access to information about mileage, which could potentially be one of the most critical savings components from implementing this new tool.

First, the possibility of having an uniform and optimal set of daily routes could mean that fewer trucks are used on a daily basis and savings could be calculated as the daily avoidance of costs relates to fuel and consumables (maintenance, tires, oils, among others) for each extra truck that stays in the DC.

In addition, fuel and consumables costs per mile should also be reduced as a result of optimal routes and access to specific delivery coordinates, both of which translate in cutting down unproductive travel miles associated to last-mile delivery.

d. Better shipment monitoring

The main value of the new system could be summarized as better monitoring of the fleet as part of the distribution activities. Most of the potential cost savings that could result from the implementation of this system have been estimated above, yet all of them are tied together to new situations that may not be completely feasible for the retailer:

- Reducing headcount.
- Freeing occupied manpower capacity to be used in less operational tasks.
- Optimizing use of the fleet.
- Reducing costs associated with deliveries.
- Improving customer service.

Far from being cost prohibitive, the value of monitoring (and recording) real-time information about the routes will be leveraging such data to strategically improve distribution policies like deliveries per truck, the definition of the route zones, and the time service estimations at stops that could be constraining the system's capacity. As the newer platform relies in standard rules to define its algorithms, performance for the whole system can now be measure against a standardize model, where data is readily available to continually adapt its planning parameters and improve the system.

7. Recommendations and final conclusions

- **Further enforce coordinate registering compliance at service desks and limit coordinate lookup geographic scope:**
  Benefits generated form the new platform will heavily rely on the availability of exact coordinates for both planning and executing delivery routes. Service desk personnel has direct contact with the client while programming the delivery, and because of it, the greater odds of correctly geolocating the delivery location. The lack of coordinates for all ensuing activities will generate a negative impact on the operation as a whole, since the systems are not completely integrated and additional exporting and importing information steps are required, the lack of

precise coordinates (or absence of coordinate at all) will translate into additional workload for the complete distribution process.

- **Delivery window implementation plan should start with deliveries for buildings and commercial places, then for deliveries at home:**
  Building on the previous recommendation, since geolocations are easier to obtain (even on a somewhat automated level) for commercial and building addresses start enforcing the delivery window constraint first with these two categories of addresses, and later on with residential addresses appears to be a smoother transition that will also allow for more information to be gained with regards to service time per stop.

- **Streamline delivery request from e-commerce channel onto the delivery programming platform, as well as importing deliveries into the new Delivery planning "Software X":**
  Non-value activities for cross registering information that's already been typed-in in a different system need to be reduced. First, for the delivery requests coming from the ecommerce platform which are currently been created based on the information received from the client once he or she completes an order, as not automating this process means that additional delays on high seasons or periods with promotions will generate a backload of orders waiting for a delivery request to be planned for fulfillment.

  In addition, exporting the delivery planning files for each truck from the original delivery programming platform to then imported into the new Delivery planning "Software X" presents another non-value step within the planning process that could be replaced by creating communication channels between the new Delivery planning "Software X" and the original delivery programming platform.

  One aspect that could potentially generate better information flow through the system to be later on used while planning is to implement tracking back coordinate data and other related delivery information from the new Delivery planning "Software X" to the delivery programming system database. Drivers are the ones who ultimately find the exact delivery location for each shipment, and because of it, coordinates for each of their visits should be recorded and compared to the one used while planning the delivery. This actual delivery location could be then used for deliveries that are made to that same client, instead of relying once again on the Google's API to find the coordinates from an address.

- **Analyze distribution performance to loosen constraints about number of deliveries:**
  Current constraints (a daily customer delivery programming limit of 15 generic and 10 construction delivery requests per route zone for each store has been set) defined based on experience that should account for time and truck size capacity feasibility could be limiting unnecessarily the distribution system.

  The new system will allow to keep a better record of service time at the stops and transit times. Even thought, the impact on customer satisfaction could be difficult to quantify, information for daily demand on request for deliveries could be recorded and then, information gathered for route times could be leveraged to strategically define more appropriate constraints or eliminate them at all.

- **Stop pre-setting load assignments to trucks and gain from the new Delivery planning "Software X" assignments instead:**
  Benefits from optimal daily routes where the load assignments for each truck have been already pre-set in a non-optimal manner will be very limited and may very well have a negative impact in the system, as a great part of the potential savings generated by the new platform are found in the workload reduction of the route planner, that under this process arrangement still needs to manually group the routes. Since the definition for what goes into a truck still remains manual, there is not a clear standardize manner that ensures that all routes are treated the same which then complicates measuring the performance of the route and comparing it to other ones.

  For this to become a reality the retailer still has work to do with regards to providing the new Delivery planning "Software X" information other than the delivery windows and delivery coordinates, like dimensions of the articles, and vehicule size and payload.

- **Finish implementing delivery tracking and make available to customer:**
  Customer satisfaction is difficult to match as a benefit of more transparent tracking information, yet for the DC, this could mean savings in the form of reducing workload for the contact center. Then, to generate savings is imperative to develop good management of alerts about ETAs and provide visibility over the status of orders and route to the client. Better reliability in geocoding is also needed, as stated in the previous recommendation.

- **Rearrange KPI dashboard:**

The routing and monitoring platform will track new information that will be beneficial to start measuring the benefit of using such platform. Key performance indicators that could be tracked by the retailer are:

- Customer Service Driven KPIs:
  - Demand on Requested Delivery Date and Delivery Window: Tracking of demand (not delivery request) could generate additional inputs to be considered for route planning as part of the capacity definition in terms of fleet size and route zones requests permitted.
  - On Time Deliveries: Clear measure of the distribution system's capacity with a direct impact to customer satisfaction. This measure could be used as an informed guide to further revise the delivery windows' quotas.
  - Perfect delivery orders: Portion of the deliveries that were delivered on time and completely (all requested items) on the first delivery attempt.
- Efficiency Driven KPIs:
  - Planning delivery time (time from request to planned delivery): Setup time for a delivery has a direct impact over shipping speed and level of service offered to the market.
  - Distance between planned location and actual delivery location: Measures the difference in distance between the actual delivery location and the location defined while planning the delivery route.
  - Planned mileage vs. Actual: Efficiency measure to keep track of route accuracy. A deviation over the planned mileage for the route will also help identify errors over delivery coordinates.
  - Vehicle Capacity Used Versus Available: Efficiency measure to keep track of the percentage of occupied volume on the truck. Benefits from the new routing and monitoring tool will increase as the number of deliveries per truck is maximized.
  - Service time at delivery locations: Time measured at each client visit for delivery. Reduction of this time will translate in more capacity for delivery requests allocations.
  - On route time: Given by the sum of the service time and travel time per route. Keeping a robust measure of the time it takes to complete a route could provide additional information to use when defining the delivery routes zone request's constraints.

        - ❑ Number of stops: Once again, the benefits of the new routing and monitoring tool will be proportional to how much more effective is the retailer in delivering more shipments per truck.
        - ❑ Tracking information record compliance: Benefits from the new routing and monitoring platform depend almost exclusively on the accuracy of the data been tracked by the new system. Driver buy-in and the information they record involving events during the route is needed to accomplish the properly measure the estimated benefits of the current process.
    - ❑ Cost Driven KPIs
        - ❑ Delivery Cost per Stop: Distribution costs (administrative manpower, drivers, consumables, fuel, maintenance, depreciation, insurance, monitoring and permits) as defined by the number of stops of each truck.
    - ❑ Triggers to Reprocessing:
        - ❑ Re-trips to same delivery stop: This measure could be affected to the increase in costs, and unplanned mileage per route. As Home Improvement Retailer's delivery price is fairly low when compared with the cost, it's critical to try to deliver shipments on the first attempt. This indicator could also provide a better idea as to the effectiveness of the alert system and the control tower performance.
        - ❑ Absence clients: Portion of the deliveries that were not completed due to the client not being in the delivery site at the specified time.
    - ❑ Already Measured KPIs
        - ❑ Daily Contact Calls
        - ❑ Average duration of calls
        - ❑ Customer complaints
        - ❑ Claims resolution
        - ❑ Undeliverable shipments

- **Redistribute available workload to habilitate control tower:**
  When the implementation of the system is completed and providing real-time analytics, the organization will have the basic elements of a hub for delivery visibility, and actionable decision-making required to triggered some of the estimates savings presented in sections above.

The contact center staff has a limited role in impacting perfect deliveries to clients, in great part because of its lack of timely information to do anything to affect a delivery that might be late (i.e. reach new delivery window agreements with the client, inform delivery personnel about changes in the route; define other options of timely fulfillment). Current recorded data does not appear to be used in the future as part of future planning delivery instances and if they continue to work just as a communication channel between the driver and the client, then again, savings from the new platform will more than likely be negative.

Even Though, the organization might be receiving alerts with more accurate information as result of better monitoring, the new insights gained from recording such information need to lead to actions to work around potential incidents and events that could be triggered by monitoring specialist that with the help of the monitoring and routing platform replace in a more efficient manner some of tasks performed by the contact center.

8. References

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Annex 1 - Google's Geocoding API used by Python Code

Objective: Obtain latitude and longitude coordinates based on address description field to be compared with retailer's recorded delivery locations

```
@author: joanp
"""
# -*- coding: utf-8 -*-
"""
Spyder Editor

"""
import googlemaps
import pandas as pd
import geopy
import geopy.distance

df_geocode_sample = pd.read_csv('GeocodeTryAdd.csv')

#This part of the code gets the coordinates based on the specific address records
gmaps_key=googlemaps.Client(key =" Replace with google's API key ")
df_geocode_sample["LAT"]= None
df_geocode_sample["LON"]= None
df_geocode_sample["Formatted_Address"]= None
for i in range(0, len(df_geocode_sample)):
    geocode_result =gmaps_key.geocode(df_geocode_sample.loc[i,'Address_Try'])
    try:
        lat = geocode_result[0]["geometry"]["location"]["lat"]
        lng = geocode_result[0]["geometry"]["location"]["lng"]
        form_ad = geocode_result[0]["formatted_address"]
        df_geocode_sample.loc[i,"LAT"] = lat
        df_geocode_sample.loc[i,"LON"] = lng
        df_geocode_sample.loc[i,"Formatted_Address"] = form_ad
    except:
        lat = None
        lng = None
        form_ad = None
print(df_geocode_sample)
```

```
#This part of the code calculates the distance between the recorded coordinate and
#the coordinates identified in the previous part of the code in km, if wanted in miles, just
change the "km" to "miles"

for i in range(0, len(df_geocode_sample)):
    try:
        coords_1 = (df_geocode_sample.loc[i,"Latitude"],
df_geocode_sample.loc[i,"Longitude"])
        coords_2 = (df_geocode_sample.loc[i,"LAT"], df_geocode_sample.loc[i,"LON"])
        coord_distance = round(geopy.distance.geodesic(coords_1, coords_2).km, 3)
        df_geocode_sample.loc[i,"coord_distance"] = coord_distance
    except:
        coord_distance = None
df_geocode_sample.to_csv(r'C:\Users\joanp\df_geocode_ex_distance.csv',
index=False)
```

Annex 2 - Contact Center Statistical Analysis

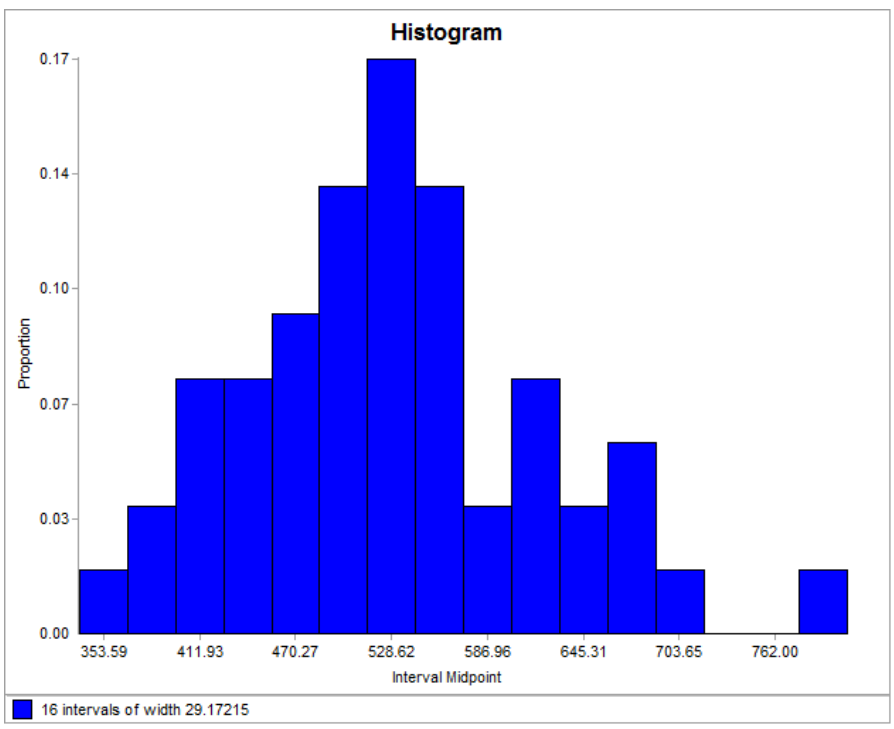
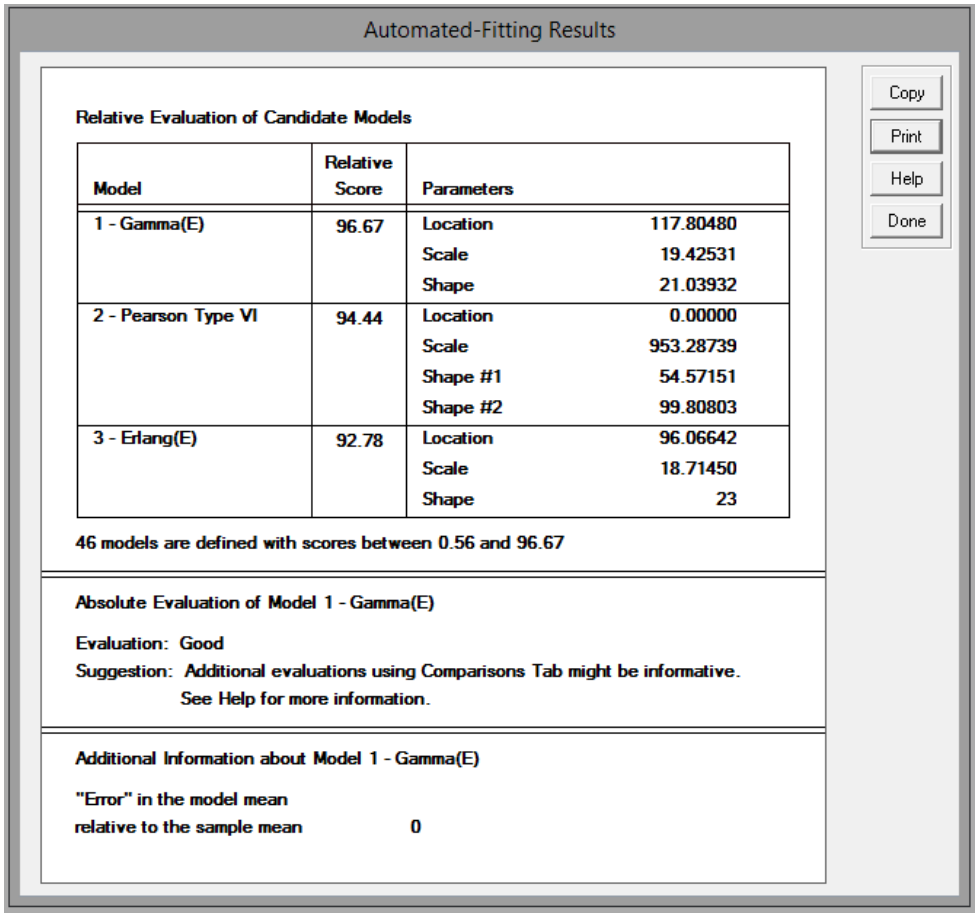


Figure 15. Daily Outgoing Calls Histogram

Automated Distribution Fitting Results



Automated-Fitting Results

Relative Evaluation of Candidate Models

Model	Relative Score	Parameters	
1 - Gamma(E)	96.67	Location	117.80480
		Scale	19.42531
		Shape	21.03932
2 - Pearson Type VI	94.44	Location	0.00000
		Scale	953.28739
		Shape #1	54.57151
		Shape #2	99.80803
3 - Erlang(E)	92.78	Location	96.06642
		Scale	18.71450
		Shape	23

46 models are defined with scores between 0.56 and 96.67

Absolute Evaluation of Model 1 - Gamma(E)

Evaluation: Good
Suggestion: Additional evaluations using Comparisons Tab might be informative.
See Help for more information.

Additional Information about Model 1 - Gamma(E)

"Error" in the model mean
relative to the sample mean 0

Copy
Print
Help
Done

Figure 16. Automated Fitting Results for Daily Outgoing Calls

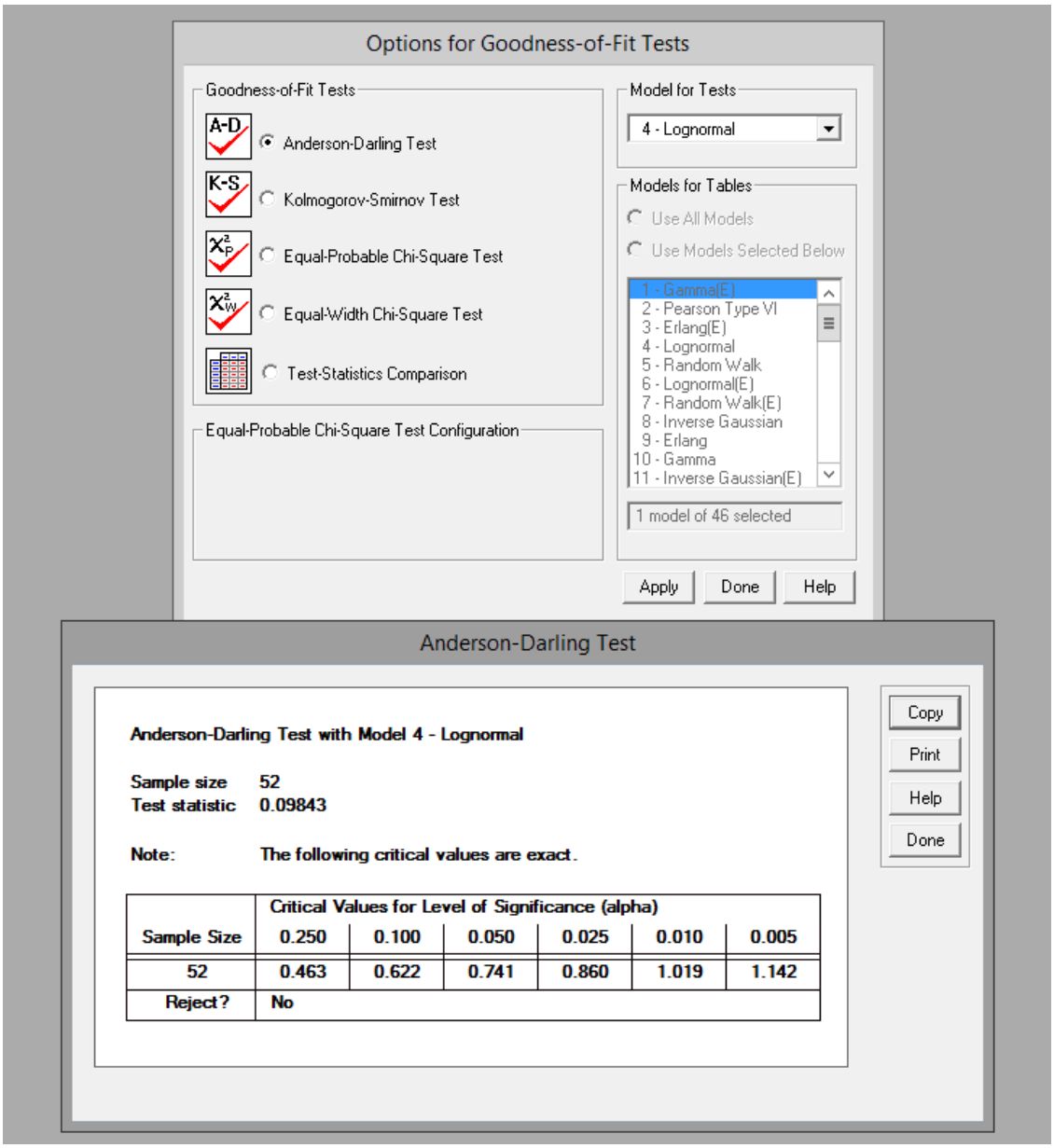


Figure 17. Goodness of Fit Results for Lognormal Distribution for Daily Outgoing Calls

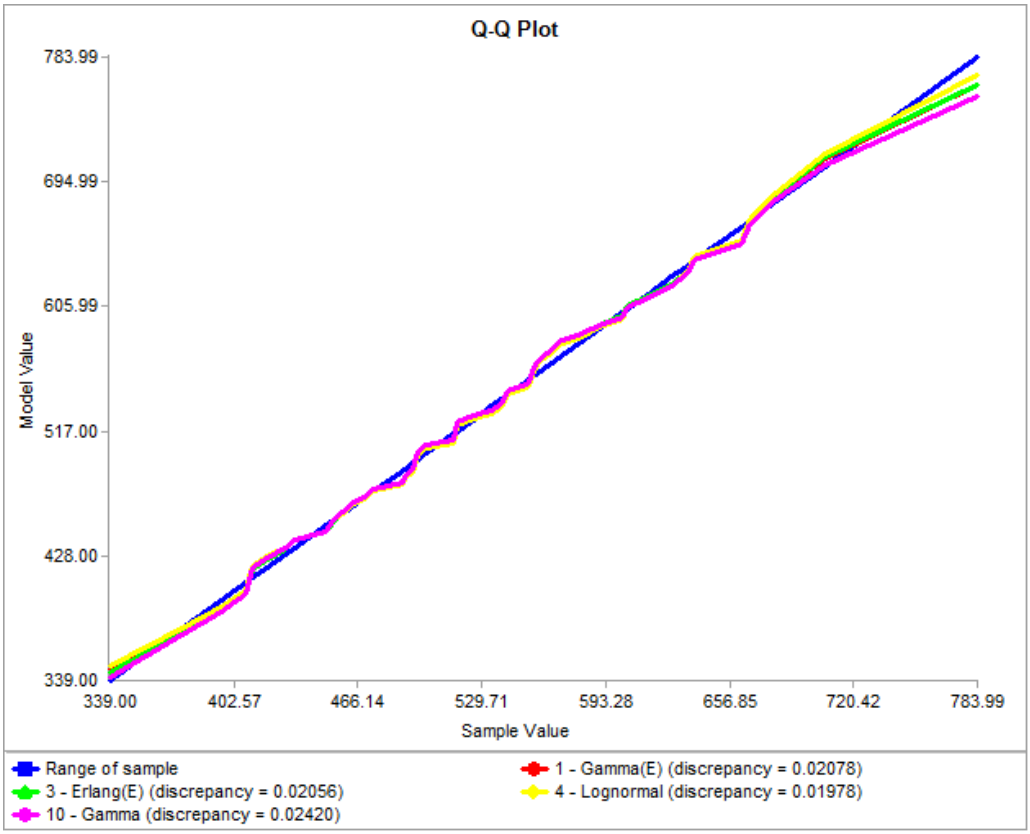


Figure 18. Q-Q Plot for Distribution Comparison – Daily Outgoing Calls

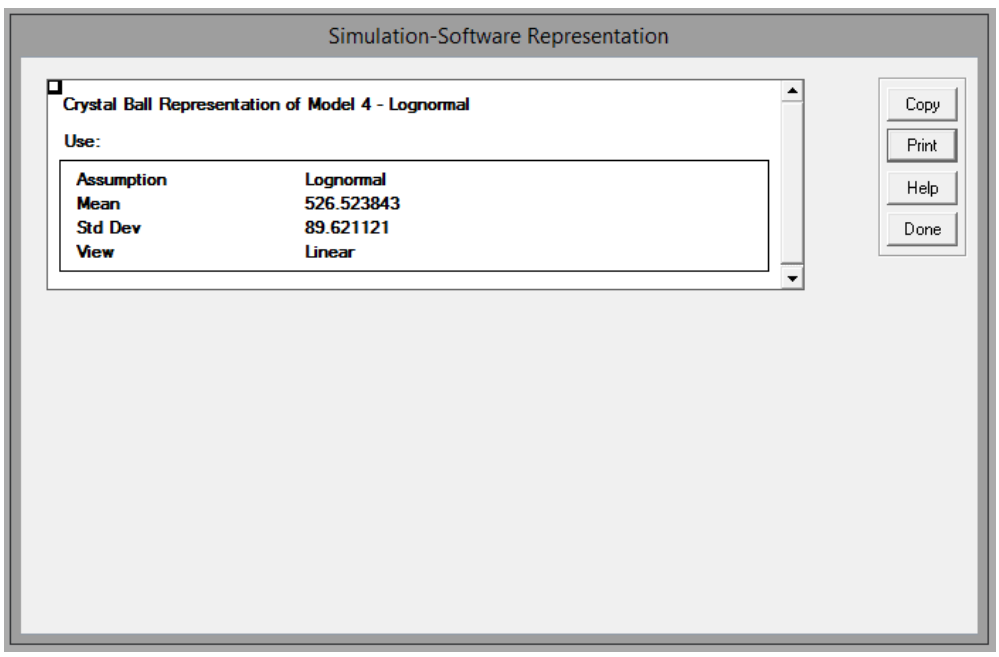


Figure 19. Distribution Parameters – Daily Outgoing Calls

Annex 3 – Details about Tax Implications for Manpower in Panama

The following tables is based on those tax payment responsibilities of employers as defined in the National Work Code – available via: http://www.ilo.org/dyn/natlex/docs/WEBTEXT/42679/67564/S9

Concept	% (as percentage of monthly salary)
Social Taxes as defined by law	
Social Security (Employer Share)	12.25%
Education Tax	1.50%
Professional Risks Insurance Savings	2.10%
Savings for Employment	
Thirteen Month	8.33%
Thirteen Month (Social Security) (8.33x10.75)	0.90%
Vacation's Savings	9.09%
Social Security (Vacations) (9.09x12.25)	1.11%
Education Tax (Vacations) (9.09x1.50)	0.14%
Professional Risks Insurance (Vacations) (9.09x2.10)	0.19%
Vacations (Thirteen Month) (9.09x8.33)	0.76%
Social Security (Thirteen Months – Vacations) (0.76x10.75)	0.09%
Antique prime over vacations (9.09% x 1.92%)	0.17%
Antique Prime	1.92%
End of Work Term Compensation	6.54%

Annex 4 – Real delivery order's experience.

Detail: In the following table we present comments for three orders that were requested to gathered information about the delivery order system for online orders from the customer experience side:

Reference Number	Item	Delivery Type	Comments
Purchase Confirmation #10928	Horno microondas samsung 800w	In Store Pickup	Order confirmed on June 25th, 2019 for pickup at Centenario Store. The item was ready for pickup well within the 2 hours of making the order. The item was placed in a shopping car by the service desk. Fiscal Invoice was issued after we ask for the order in the store. Total time in store was 12 min.
Purchase Confirmation #10930	Cafetera blanca de 12 tazas	In Store Pickup	Order confirmed on June 25th, 2019 and picked the same day in 10 de Octubre Store. The item was stored in the service desk, properly packaged with the fiscal invoice already issued and attached to the order. Total time in store was 3 minutes.
Purchase confirmation #11081	Soporte Magnético Para Celular Con Puerto USB (store pickup) Abanico negro de pedestal de 16" (direct-to-client delivery)	Direct-to-Client Delivery and In Store Pickup	**In-Store Pickup:** The order confirmed for pick up and picked the same day in Santa Maria Store (July 1st, 2019) The staff had problems picking the order, the specific item for store pickup wasn't located until 15 minutes after presenting the order at the service desk in the store. The staff had doubts because the invoice amount and what the cashier system was displaying wasn't the

			same amount. They were trying to complete the order for the two items (one was for store pickup and the other was for direct to client delivery). After my request, the staff decided just to hand over the item for store pickup and left the fan for direct delivery, as originally requested. Time in store: 30 minutes. **Direct-to-Client Delivery:** The confirmation email detailing that the order was planned for delivery was received on July 3rd, 2019. On the day of the delivery (July 4th, 2019) the contact center sent me an email asking for a new contact number as the specific number on the order wasn't available. I provided a new phone for them to contact me. 10 minutes after that the contact center called me and generated a conference call with me and the general helper in the trucks. The General Helper asked for details about how to get to my specific location. The delivery van reached my placed about 3 minutes after that. Once there, the order was handed over and my signature was requested on the space detailing my specific address in a copy of the delivery plan. Furthermore, I was able to see the information for other deliveries that were included within the same delivery plan page.