Verification and Cost-Benefit Analysis of RedPack Services

University of Pittsburgh – Industrial Engineering Project

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Introduction

With the success of part proximity services in Europe, migration of similar services into North America has begun in order to take advantage of the lack of competition in this sector of the transportation logistics market. Part proximity services are companies solely focused on bringing field technicians, repair parts, and end customers closer together through improved logistics and information processes and RedPack Network is one of the leaders in this migration into North America. Based in Pittsburgh, Pennsylvania, RedPack Network claims to provide the following benefits to its client customers:

- Reduce technician drive time
- Increase technician's productivity
- Increase service level compliance
- Reduce courier costs
- Increase parts return rate

In testing to validate the company's claims of reduction in travel time and increases in technician productivity, a simulation model of the current service method and the RedPack service method was conducted by the University of Pittsburgh in order to verify the cost-benefit tradeoffs customers would realize when switching over from their current solutions to the RedPack solution.

Simulation Models

For the current service method model, the simulation model was constructed to mimic field service organizations whose service structure consists of their service technician collecting parts from a warehouse or branch office in the morning before any end customer receives any type of service.

In order to develop the current simulation model, some assumptions were made to effectively model a representation of the current method of field technician service.

List of Assumptions

- The simulation will only be conducted on service technicians in Allegheny County
- All BP and 7-Eleven 24/7 locations are possible for utilization as an ARC location and there will be no capacity limitations placed upon any of the 24/7 locations.
- Technicians have different skill levels, but only the skill set will determine which technicians are able to service a job; not skill level expertise. A technician with a skill level of beginner will not be passed over in favor of an expert technician solely based on skill level expertise.
- There are two available warehouses in Allegheny County and both warehouses hold the same inventory.
- Technicians pick up all of their parts for the day in the morning at one of the two warehouses. The pick up parts from the same warehouse everyday.
- There are two types of SLAs: 4 hour and 24 hour.
- Technicians who receive 4 hour SLA services need to travel back to the warehouse in order to pick up required parts because they will not have the part with them.
- All 24 hour SLAs are fixed the next day, and all 4 hour SLAs that are called in after 2 pm are also served the next day.

- To calculate travel times for travel distances the following would be accurate
    - Three minutes per mile for the first ten miles
    - 1.2 minutes per mile for ever mile after ten miles

Data Distributions

Arrival Rate Distribution

In general, arrival rates are normally fitted to exponential distributions, this is because arrivals are completely random and are highly variable. Therefore an input analyzer was utilized to fit the arrival time of customer calls to the appropriate exponential distribution, and the result of the analysis was that for the data provided the arrival time for the customer calls into a dispatch center were exponentially distributed with a rate of 6.8 calls per hour

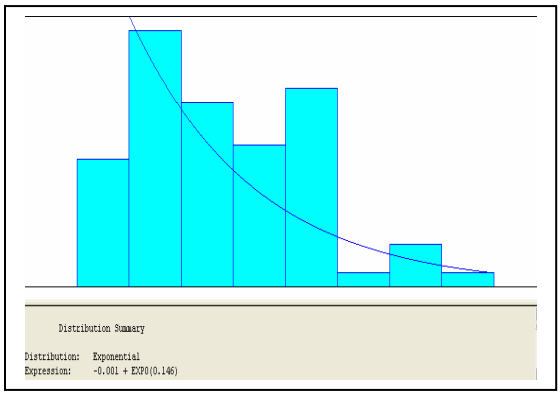

Figure 1: Arrival Rate Distribution

Travel Rate Distribution

In general, travel rates are normally fitted to normal distributions, because travel times usually converge around a similar mean. Therefore an input analyzer was utilized to fit travel tims to the appropriate distribution, and the result of the analysis was that for the data provided the travel time between customer locations were normally distributed with a mean mostly around 25 and a standard deviation close to 5.

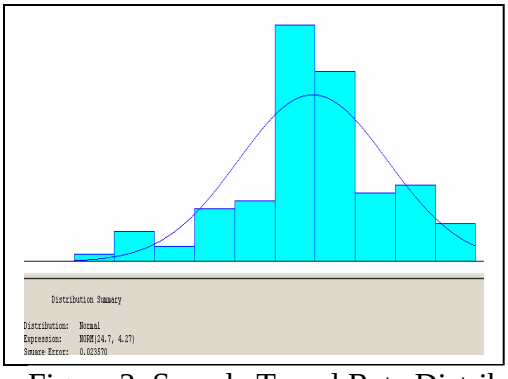

Figure 2: Sample Travel Rate Distribution

Nodes and Distance between Customers

In order to derive the travel distances between consecutive customer locations, a road network system was developed in order to incorporate the travel statistics for each customer location to all other customer locations. In order to account for the randomness in travel time and easily determine where calls where coming from, nodes where created to represent geographic areas of Allegheny County, PA; see figure 3 to geographically view how nodes can represent the different geographic areas of Allegheny County, PA This created a travel matrix consisting of all customer locations and the travel distances from individual customer locations to all other locations utilized in the system. Using the information obtained by creating the travel nodes, the travel distances for each customer location where aggregated and distributions for travel time in between nodes replaced the travel time distributions for individual customer locations.

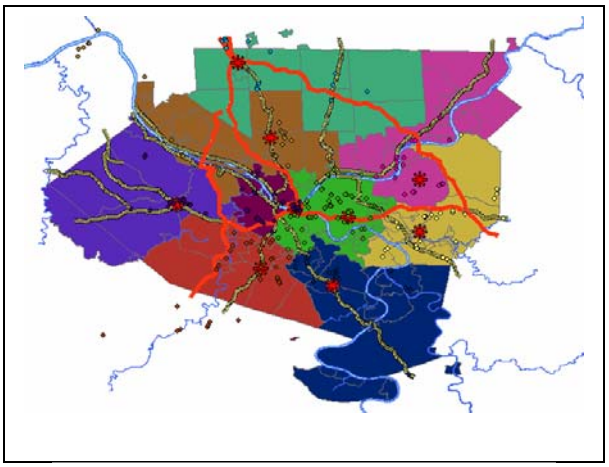

Figure 3: Allegheny County Nodes

Key Simulation Statistics

- Technician Drive Time : Hours spent traveling
- Technician Mileage : Number of miles traveled
- Emergency Travel Time: Hours spent traveling when technician needs part
- Emergency Travel Mileage: Number of miles traveled when technician needs part
- To and From Miles: Number miles traveled to and from warehouse and start and end of shift

Current Method and RedPack Method Simulation

The current method and the RedPack method of equipping field technicians with parts for end customer service are very similar, with the difference being that under the RedPack method the technician does not go to a warehouse to collect service parts for the end customer, rather they go to the ARC location where the part has been dispatched. Because the ARC Locations are closer to the end customer and the number of available ARC Locations in a geographic area is higher than the number of warehouses any individual field service company would have under the current method, the average travel time from a customer location to an ARC location is significantly less than the average travel time from a customer location to a field service company's warehouse. Comparisons of the Technician Drive Time, Technician Mileage, Emergency Travel Time, Emergency Travel Mileage, and To and From Miles for the current method simulation and the RedPack method simulation verified this significant difference

Face Validity and Verification of Models

Once the models were complete, tests were completed to verify that the model was valid, ensuring that the model depicts what is typically seen in field service part distribution processes and that the model is credible to an acceptable level. To verify that the models were built correctly, flow diagrams were constructed and reviewed with RedPack in order to confirm the various decisions that are made by dispatchers and the various events that are undertaken by service technicians when servicing and end customer repair. This ensured that our models would represent the correct systems. Additionally, statistics were collected from the simulation models to ensure that the right outputs were obtained and that the results made logical sense; these results included: service time, travel time, and number of calls serviced in a week. These were then compared to the data provided.

Travel times were discussed with RedPack since no data was available and a series of model debugging was also conducted. During this, the simulation was watched step-by-step in an effort to ensure that all events were working properly and the jobs were being assigned logically. Field technician utilization was also collected to verify that the algorithms in the system used to assign jobs to technicians were working properly; the utilization of technicians can be seen in figures 4 and 5.

The steps taken to check the model verified that the model was built properly and the resulting output was of acceptable accuracy. High face validity was achieved by working with professors to build the model correctly and working with RedPack to confirm outputs depicted the real life process.

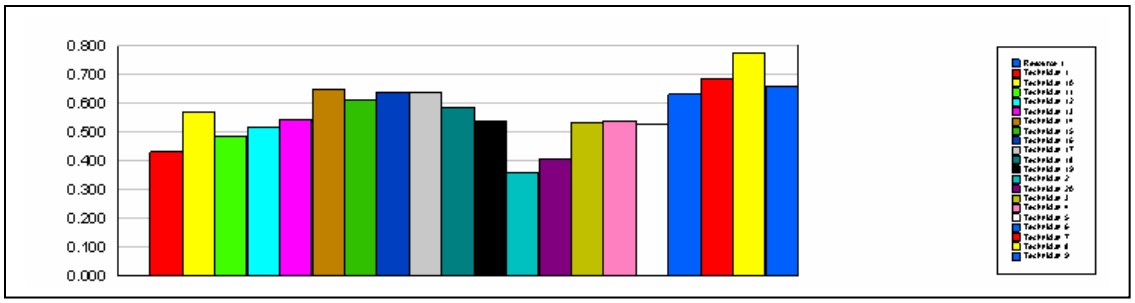

Figure 4: Current Method Technician Utilization

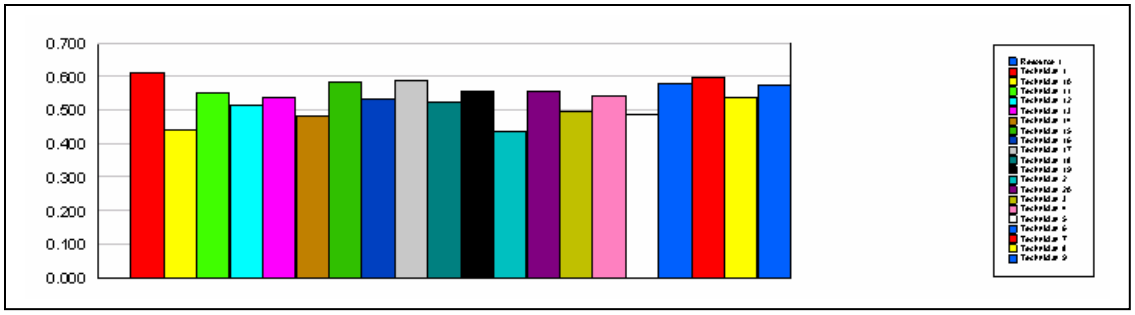

Figure 5: RedPack Method Technician Utilization

Cost-Benefit of RedPack Method vs. Current Method

In order to determine the financial impact for potential customers migrating from the current model to the RedPack model, a cost benefit analysis was completed. Travel statistics from the simulation were used to determine the cost of each method. For the current method, the cost of the technician's time used traveling between customers and the cost associated with the technician's time spent traveling to and from the warehouse when a part is needed was calculated. The miles spent traveling between the customer locations, the miles spent traveling to the warehouse if a part is needed, and the miles spent traveling to and from the warehouse at the beginning and end of each day were included in the costs associated with current method.

The RedPack analysis included all costs associated with the current method along with two other additional costs, RedPack carrier cost and ARC cost. The RedPack carrier cost is associated with the number of deliveries to each RedPack location. This is charged to RedPack's customers at the cost of $10 per delivery. The ARC cost is the cost per package delivered to the ARC locations. RedPack charges one dollar per package delivered resulting in an average cost of $100 per week.

The results of the cost benefit analysis show that RedPack can save its customers approximately 16.19% a week in transportation costs. This results in an average saving of $1,974.07 each week. Annually, these cost savings exceed $102,000.

It should be noted that these costs savings will vary per customer. These savings can only be statistically accurate for the area which was studied and analyzed. Additional cost savings can be observed if a company pays for their technicians time travel to and from the warehouse at the start and end of their day. Additionally, geographic location

will have an affect on the amount of money saved. Companies who service large geographical areas will see higher cost savings than those whose areas are in more compact areas. Our analysis also assumed that each warehouse contained the same inventory, and in most organizations this would not necessarily be true. Therefore, an increase of cost savings could be obtained if field technicians were not able to utilize the closest warehouse and instead had to travel to a more distant warehouse.

Current Method Costs				
	Weekly Metrics		Unit Cost	Total Cost
Technician Travel Time	114.76	hours	$50.00	$5,737.92
Technician Mileage	2295.17	miles	$1.00	$2,295.17
Emergency Travel Time	21.83	hours	$50.00	$1,091.39
Emergency Travel Mileage	671.3	miles	$1.00	$671.30
To and From Miles	2400	miles	$1.00	$2,400.00
			TOTAL	$12,195.78

Chart 1: Current Method Cost

RedPack Method Costs				
	Weekly Metrics		Unit Cost	Total Cost
Technician Travel Time	111.37	hours	$50.00	$5,568.42
Technician Mileage	2227.37	miles	$1.00	$2,227.37
Emergency Travel Time	9.66	hours	$50.00	$482.80
Emergency Travel Mileage	193.12	miles	$1.00	$193.12
To and From Miles	1000	miles	$1.00	$1,000.00
RedPack Carrier Cost	45.00	delivery	$10.00	$450.00
ARC Cost	100.00	technician pkgs	$3.00	$300.00
			TOTAL	$10,221.71

Chart 2: RedPack Method Costs

Chart 1 and Chart 2 show the cost differential for the field service organization in Allegheny County that we simulated. Chart 2 shows that there is a significant improvement in the amount of emergency travel time and emergency travel mileage encountered when the RedPack service method was utilized for the data set. Even with

the additional costs the company would have to take on in order to utilize RedPack's ARC locations, the company savings in just travel metrics alone covers the cost of operating in conjunction with RedPack. These two charts show that the claims that RedPack reduce technician drive time and increase technician's productivity are indeed valid, as it can be seen that technicians spend less time traveling when using the RedPack ARC locations and have more available time to spend at end customer repair sites.

Recommendations

It is recommended that field service organizations utilize the RedPack method instead of the current method being used in order to get service parts in the hands of their field technicians as efficiently as possible. With significant savings in technician travel time, technician mileage, emergency travel time, and emergency travel mileage organizations utilizing RedPack ARC locations will be able to reduce technician drive time, increase technician's productivity, and likely increase service level compliance with their end customers. With savings of approximately 16.19% of current costs, the RedPack method offers its clients a more efficient and financially beneficial solution to providing field technicians with the parts they need to service repairs.