Disabled Adult Transit Service:

Optimum Shift Design and Demand Forecasting

Prepared for:

DATS
Transportation Department
City of Edmonton

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I. EXECUTIVE SUMMARY

Executive Summary: Optimum Shift Design

With the Disabled Adult Transit Service’s (DATS) collective agreement expiring in December 2009, it is advantageous for DATS to perform an analysis of their current workforce performance. As a result, our client asked us to analyze their current shift scheduling system in order to build for them a shift scheduling model that is able to quantify the benefits from varying combinations of full-time and part-time operators (with an overtime reduction perspective in mind as well).

We built such a model, and then analyzed DATS’ current shift schedule against other possible schedules that met a series of supply constraints. The model was optimized to meet demand while also minimizing daily operator costs. The utilization rate of these operators was another key performance indicator in deciding on a recommended shift schedule for our client. Our analysis revealed that a greater number of part-time shifts implemented into DATS’ schedule reduced their daily costs. As well, more part-time operators reduced overtime costs, and increased productivity.

Executive Summary: Demand Forecasting

DATS’ demand has experienced a quick and significant increase. As a result, they need a means to accurately and reliably forecast this demand in order to effectively manage it. The city of Edmonton’s official population forecast to 2030 predicts an aggressive aging of its population under two scenarios (Base Case and High Scenario). Since age, along with gender, are leading indicators for, as well as key drivers of, the disabled population, Edmonton’s aggressive aging will also result in an increase in its disabled population. Assuming that this relationship is linear, a simple linear forecast revealed that an almost doubling of Edmonton’s 65 and over age group resulted in a 62% and 72% increase in its disabled population under the Base Case and High Scenario, respectively. Since Edmonton’s disabled population is a key driver of the demand for
DATS, such an increase will also drive an aggressive increase in this demand. Again, a simple linear forecast revealed that the demand for DATS increased by 234% and 256%.

If DATS accepts all of this forecasted demand as clients, and if its total number of clients is the exclusive driver of its total number of employees, vehicles, and operating expenses, then the impacts of this forecasted demand on DATS’ ongoing operations are significant. Under the Base Case, DATS’ number of employees will increase by 268%, vehicles by 215%, and its operating expenses by 197%; while under the High Scenario, employees by 293%, vehicles by 235%, and its operating expenses by 215%. As a result, it is essential that DATS effectively manages these potential impacts with three cost containment strategies: redirecting this forecasted demand to other non-city organizations that also provide assisted transportation services; employing a more optimal mix of both full-time and part-time operators in conjunction with a more optimal shift schedule; and modifying DATS’ current approach of providing door to door service into a more centralized pickup and drop off service.
II. PROJECT BACKGROUND

The Disabled Adult Transit Service (DATS) provides transit services for people with disabilities. DATS is a part of the Edmonton Transit System (ETS). DATS’ operators offer door to door service, which allows their clients to travel safely between their homes and the bus. The demand for DATS is ever growing, hand in hand with the growing, and aging, population of Edmonton.

To use DATS, clients must be registered in DATS’ database. To date, there are approximately 10,000 clients in this database. DATS is only for individuals 16 years or older who have a disability and cannot use regular transit. DATS categorizes these individuals into two different types of clients: ambulatory passengers and wheelchair passengers. DATS contracts its ambulatory services. Clients are also allowed to have an attendant accompany them on trips, free of charge. DATS’ lift vans can carry different combinations of wheelchair and ambulatory passengers, depending on the type of van: flip buses can be made to carry different levels of capacity, while non-flip buses have a fixed capacity of five wheelchair passengers and four ambulatory passengers.

DATS’ dedicated service trips and operating expenses have increased quickly and significantly since the early 2000s, indicating that DATS is becoming more of a demanded service. As a result, accurately and reliably forecasting this demand in order to effectively manage it in the future is becoming more necessary.

DATS operates Monday through Sunday with varying hours. DATS faces peak times because of higher demand from 7:00-10:00 and 14:00–17:00 on weekdays. Their weekday demand is much greater than on weekends. Clients must reserve a pickup 24 hours in advance in order to guarantee their ride. While DATS also accepts requests for same day pickups, they do not guarantee these rides.
III. PROBLEM DEFINITION

*Problem Definition: Optimum Shift Design*

DATS’ current collective agreement with the union in the Labour Management Consultation Committee is expiring, and DATS now believes that its current operations may be improved through an optimizing shift schedule analysis. DATS’ operations are heavily influenced by peak hours, and by overtime (OT) hours occurring outside of statutory holidays- not because of operators working beyond their scheduled shift length, but because of full-time (FT) operators covering shifts on their days off. This results in these operators being paid twice their current wage rate. Nonetheless, these challenges can be overcome by increasing the flexibility of DATS’ current shift schedule through a mathematically devised optimum combination of FT, PT, and OT shifts.

On an average weekday, for every DATS operator scheduled, 1.9872 units of demand are met on an hourly basis. Figure 1 depicts the hourly wheelchair passenger demand along with the current operators scheduled to meet this demand. Using the metric of 1.9872 units of demand per operator, a theoretical line is also shown that would meet demand perfectly when maximizing operator utilization. The gap between these lines illustrates an opportunity for improving the performance of DATS’ current shift scheduling system.

*Figure 1: Wheelchair passenger demand and operators scheduled*
Problem Definition: Demand Forecasting

The city of Edmonton has seen a substantial increase in growth over the past few years. This growth affected the demographics of the city as well as its social conditions, and, thus, the disabled population. As a result, the demand for DATS is rapidly changing, and DATS lacks a reliable system to accurately anticipate and react to these important changes. Therefore, DATS now believes that it would be beneficial to comprehensively review its past and present demand in order to then allow it to accurately and reliably forecast its future demand. With this forecast, DATS also believes it can accurately and reliably plan its future.
IV. SOLUTION CRITERIA

Solution Criteria: Optimum Shift Design

To address the issue of high operating costs when satisfying demand, a thorough analysis of DATS’ shift schedule was conducted, with a focus on the efficacy of operator shifts, and weekday service (since it is of the greatest concern to DATS due to a majority of worker hours logged versus weekend and holiday service). Our solution was to provide DATS with sound information to help them construct an optimal combination of FT, PT, and OT shifts (such information may also be useful during the new collective agreement negotiations that will begin in December 2009).

We undertook this challenge by inputting DATS’ current shift schedule into a shift scheduling model that we built with Microsoft Excel. This model takes into account the number of operators being scheduled to meet demand, as well as their shift lengths, labour costs and utilization rate. Our recommended combination of FT and PT operators, and shift schedule will be based on the measured findings that will have the lowest labour costs while still meeting demand at a chosen service level (based on the expectations of DATS’ clients).

Solution Criteria: Demand Forecasting

To address the issue of rapidly changing demand for DATS, we analyzed forecasts of Edmonton’s total and disabled population in order to understand what affects the past and present changes in these populations have had on the past and present demand for DATS. Forecasting the demand for DATS then required multiple steps.

First, the relationship between Edmonton’s total population and Edmonton’s disabled population needed to be investigated—specifically for the co-relation between certain demographic characteristics (age and gender) of Edmonton’s total population and the number of disabled people residing within Edmonton. Having found such a relationship, it then needed to be defined in terms of a mathematical equation. Second, the relationship between Edmonton’s disabled
population and the demand for DATS also needed to be investigated. Once again, having found such relationship, it needed to be defined in terms of a mathematical equation. As a result of these relationships being quantified, it was possible to forecast the demand for DATS based, initially and primarily, on the forecast of Edmonton’s total population- specifically, its age and gender profile.

Next, and most importantly, the impacts of this forecasted demand for DATS on its ongoing operations needed to be investigated- specifically for capacity (defined as DATS’ total number of employees and vehicles, as well as its total operating expenses). Finally, recommendations for managing these impacts needed to be created by using criteria that emphasize cost containments.
V. METHODOLOGY

*Methodology: Optimum Shift Design*

To build our shift scheduling model, we first had to establish an outline of some of the methods that we were going to use to guide this project. The outline that was created was composed of these steps:

1. **Complete a thorough review of DATS’ current shift design.**

   Determine what drives the current shift schedule; that is, how and for what reasons are operators scheduled. To actually determine this, the current utilization rates of drivers were analyzed, and inquiries were made to DATS on a daily basis to leverage their detailed expertise.

2. **Analyze the various inputs that are used for DATS’ scheduling.**

   This included researching the daily demand for DATS. Demand was chosen to be wheelchair passengers, and the data given by wheelchair passengers scheduled for pickups (SCHED_WC) with wheelchair passengers who cancelled their booking ahead of time (CANCEL_WC) subtracted. Data for supply were also needed; thus the quantity of fleet on hand was discovered, along with shift lengths, number of part-time (PT) and FT operators on staff, and the amount of OT hours worked.

3. **Identify the performance indicators that would guide the model for true optimization.**

   DATS satisfies demand at a 100% level for all registrants that made advanced bookings (24 hours prior to pickup). Operator costs vary with experience; moreover, wage increases with the amount of hours logged as an operator.

4. **Identify opportunities for improvements in the current shift schedule.**

   A metric for how many units of demand are met by a single operator was calculated by dividing total passengers carried per operator by the total hours worked by that respective operator for all data given. An average was then taken to determine this metric. This figure (1.9872) aided the examination of operator utilization and the understanding of where and when operators should be scheduled to satisfy 100% of scheduled wheelchair pickups.
5. **Acquire and analyze data pertaining to hours worked in relation to OT.**

An OT reduction perspective was adopted in order to understand how different shift-types can be more effective at satisfying the demand that is currently being satisfied by OT shifts. An in depth breakdown of OT hours worked over the past two years was performed to gain this understanding.

6. **Build a shift scheduling model.**

The model was built on the basis of Queueing ToolPak 4.0 (QTP), which is an Excel based add-in. QTP works as a stationary independent period by period approach (SIPP), which segments the workday into planning periods (shifts), and QTP is constructed for each planning period (in our case, every quarter hour). The model was run to minimize daily operator costs while staying within certain constraints. QTP was incorporated into the model by being used to establish the number of operators required to meet our chosen service level. QTP took into account the distribution type of customer arrivals, as well as the threshold time, service level, arrival rate, service rate, and queue capacity levels. The model was made to analyze many different combinations of shifts by tactical planning, and examining the daily scheduling of operators to meet the forecasted daily demand. The model was ultimately focused around minimizing daily operator costs while meeting given criteria. This was achieved by using Solver within Excel. For more information on using the shift scheduling model, see Appendix 9; on QTP, see Appendix 10.

7. **Complete scenario and sensitivity analyses for shift scheduling model.**

A scenario analysis was completed by inserting many different schedule types into the model, and then running the model to minimize operator costs. All resulting costs were compiled and compared in sensitivity analyses in order to understand which shift combination was to be recommended to DATS.
Methodology: Demand Forecasting

To forecast the demand for DATS, the following steps were undertaken:

1. **Identify the leading indicators / key drivers for the disabled population.**

A broad literature review was conducted to find the leading indicators / key drivers for the disabled population. This review discovered that the generally accepted leading indicators / key drivers are age and gender.

2. **Forecast Edmonton’s total population.**

In 2005, the city of Edmonton commissioned a forecast for Edmonton’s total population to be used for all official social and economic planning. This forecast was prepared for two scenarios: Base Case and High Scenario. The Base Case used a conservative extrapolation of Edmonton’s recent growth to forecast its economic and population growth, while the High Scenario used more optimistic assumptions to forecast stronger economic and population growth.

This forecast only profiled Edmonton’s total population by age, and not by gender as well. To determine the gender profile of each age group, historical data on the gender distribution for each group was obtained. Since this distribution appeared relatively stable over the past decade, it was assumed that the gender profile would continue to adhere to this relatively stable linear change for the forecast period. Based on this assumption, the percentage of males and female for each age group was forecasted, and then used to profile Edmonton’s official total population forecast by gender as well as age.

3. **Forecast Edmonton’s disabled population.**

No specific and readily available data exist on Edmonton’s disabled population. However, data exist on Alberta’s disabled population for the years 2001 and 2006. Consequently, to determine Edmonton’s disabled population, Edmonton’s total population as a percent of Alberta’s total population for each age and gender cohort was calculated for the years 2001 and 2006. It was then assumed that this percent also applied to Edmonton’s disabled population for the years 2001 and 2006, which allowed Edmonton’s disabled population to be calculated by age and gender cohort for the years 2001 and 2006.
However, it is important to note that two data sets (the years 2001 and 2006) are insufficient to conduct a proper multivariable regression analysis. As a result, the explanatory power and correlation between the age and gender profile of Edmonton’s total population and the number of disabled people residing within Edmonton could not be determined. Nonetheless, the relationship between the age and gender profile of Edmonton’s total population and Edmonton’s disabled population was assumed to be linear.

This linear relationship was then used to forecast Edmonton’s disabled population by age and gender based on the forecast of Edmonton’s total population. Again, however, two data sets (the years 2001 and 2006) are insufficient to conduct multiple forecast methods. As a result, only a simple linear regression was used to forecast Edmonton’s disabled population by age and gender based on the forecast of Edmonton’s total population.

4. Forecast the demand for DATS.

DATS only tracks officially registered clients, and not also the people that are inquiring about its services. As a result, no indicator exists for the actual demand for DATS. Nonetheless, it was assumed that the number of officially registered clients could also serve as a surrogate indicator for the demand for DATS.

Again, unfortunately, two data sets (for the years 2001 and 2006) for Edmonton’s disabled population are insufficient to conduct a proper multivariable regression analysis between this population and the demand for DATS. As a result, the explanatory power and co-relation between the age and gender profile of Edmonton’s disabled population and the demand for DATS could not be determined. Nonetheless, the relationship between the age and gender profile of Edmonton’s disabled population and the demand for DATS was assumed to be linear.

This linear relationship was then used to forecast the demand for DATS by age based on the forecast of Edmonton’s disabled population. Again, however, two data sets (the years 2001 and 2006) are insufficient to conduct multiple forecast methods. Consequently, only a simple linear regression was used to forecast the demand for DATS by age based on the forecast of Edmonton’s disabled population.

5. Identify and forecast the impacts of this forecasted demand for DATS.

Understanding the impacts of this forecasted demand on DATS is very important to them. To forecast these impacts, historical data on DATS’ total number of clients, employees, and vehicles,
as well as its total operating expenses was obtained. It was then assumed that the exclusive driver of DATS’ total number of employees and vehicles, as well as its total operating expenses was its total number of clients. It was also assumed that: all other cost drivers are constant (such as inflation, employee salaries, and vehicle maintenance expenses); decision makers will not intervene (by, for example, actively increasing or decreasing the number of clients, employees, or vehicles); and productivity will not change (by, for example, using larger vehicles, which, in turn, require fewer operators overall, to transport more clients).

Based on these assumptions, the average marginal changes to DATS’ total number of employees, total number of vehicles, and total operating expenses per marginal change to DATS’ total number of clients was calculated. It was then assumed that DATS would indiscriminately and unconditionally accept all of its forecasted demand as clients. As a result, these averages and this forecasted demand were used to forecast DATS’ cumulative number of employees and vehicles, as well as its cumulative operating expenses.
VI. ASSUMPTIONS

Assumptions: Optimum Shift Design

The following are the assumptions that were made for the shift scheduling model:

1. All demand data analyzed was configured to represent SCHED_WC minus CANCEL_WC. Although no shows cause additional problems, they were ignored for this analysis because bus drivers are still scheduled for these pickups, and must still perform these runs. Same day demand was also ignored because of its relatively small number of occurrences on a daily rate, and there is no guarantee to the clients that their want for a ride will be met.

2. Demand data was given on a yearly basis per quarter hour. These data points were divided by the days DATS operates within a year (365) to recognize the average daily demand for wheelchair passengers. To account for varying levels of demand on weekday and weekend service, a weighted average was computed and is seen in Figure 2. Demand values were analyzed and met through a conservative approach by rounding all demand values up to the nearest integer for each quarter hour.

Figure 2: Calculation of total wheelchair passengers scheduled for pickups

<table>
<thead>
<tr>
<th>Demand Period</th>
<th>Total SCHED_WC - CANCEL_WC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Weekly</td>
<td>672.28</td>
</tr>
<tr>
<td>Avg Wed (2 data points)</td>
<td>841</td>
</tr>
<tr>
<td>Avg Sat (2 data points)</td>
<td>334</td>
</tr>
<tr>
<td>Avg Total Weekday Demand</td>
<td>812.1716</td>
</tr>
</tbody>
</table>

3. Operator productivity was chosen to be the average number of passengers carried per single operator. This value equated to 1.9872. Thus, per every 1.9872 units of demand, 1 operator should be scheduled to completely satisfy demand. This value was also used as the service rate in our QTP function, but broken down for each quarter hour, which equalled 0.4968.
4. For QTP, many metrics had to be chosen to perform the function properly.

   a. The arrival process of clients follows a Poisson distribution, and is, therefore, a memoryless process (M). DATS service process is also memoryless (M) because its inter-event times (the amount of time since an operator’s last pickup) contain no information about this amount until the next pickup. Although the operators average 1.9872 clients per hour, some pickups may be very close to one another, resulting in a larger pickup rate, while others may be very far, resulting in a smaller pickup rate. With these qualifications, the queuing system chosen was M/M/S.

   b. The threshold time is used to specify how long customers should wait, given an explicit service level. Clients are given a half-hour window to be picked up (that is, if a client books a pickup for noon, he / she should expect to be picked up anywhere between 11:30am and 12:00pm), and the average drop-off times are consistently within 30 minutes. Accordingly, the threshold time is 0.5 hours.

   c. The service level is quite high for this queuing system because of DATS’ goal to service all reserved bookings within this half hour window. Our selected service level is 0.99- meaning that 99% of passengers should expect to be picked up within 30 minutes (the threshold time) or less. The reasoning behind such a high service level is that it is able to reduce human (operator) error effecting the pickup time. Traffic and human errors are externalities that will affect the service rate, but our high selected service rate will minimize these errors tremendously. A 99% service level makes the probability of an operator being late for a pickup occur once in a hundred pickups, with lateness being minimal.

   d. The arrival rate for our QTP analysis was the demand data broken down into quarter hours as mentioned in Figure 3. Operators were scheduled for the arrival rate by averaging the two periods in advance. This was performed because of the time it takes to execute certain duties prior to leaving the depot (such as vehicle inspections, punch-in times, etc.), and to arrive at a registrant’s location averaging to thirty minutes. DATS has a high average service time compared to most queueing systems; thus a variant SIPP
approach was needed. Under DATS’ circumstances, there is a time lag between an operator starting work and then that operator clocking in on the Mobile Data Computer (MDC)- which tracks the time spent by an operator performing trips. However, the use of a Lag SIPP approach corrected for this gap between services, whereas a normal SIPP approach would not have.

5. Shifts did not take into account break time. The only breaks incorporated into the tours were for split shifts in the current shift schedule.

6. Tours were inserted into the system 0.5 hours shorter than their actual length in order to immediately stop operators from performing additional pickups outside of their shift length.

7. The model does not schedule OT because an analysis showed that OT is only scheduled due to statutory holidays, or to cover shifts.

8. Since a large portion of the demand data was not broken down into individual days, all demand after 23:00 was assumed to be demand for weekend service.

9. Ten PT operators were not scheduled per day because there are currently 14 PT operators, and if all were eligible to work, they would only be available on certain days before their PT 40 or 60 hours are exceeded.

10. PT shifts are designated to be 7 hours or less.

Assumptions: Demand Forecasting

As previously mentioned throughout the Methodology section, several assumptions were made in order to forecast the demand for DATS and its impacts on DATS. The following is a summary of the data limitations that necessitated these assumptions:
1. Edmonton’s official population forecast is only profiled by age, and not also by gender.

   a. Since the historical gender distribution for each age group appeared relatively stable over the past decade, it was assumed that the gender profile of each age group will continue to adhere to this relatively stable linear change for the forecast period.

   b. Based on this assumption, the percentage of males and female for each age group was forecasted, and then used to profile Edmonton’s official total population forecast by gender as well as age.

2. No specific and readily available data exists on Edmonton’s disabled population; only on Alberta’s disabled population for the years 2001 and 2006.

   a. It was assumed that Edmonton’s total population as a percent of Alberta’s total population for each age and gender cohort for the years 2001 and 2006 also applied to Edmonton’s disabled population for those same years.

   b. This allowed Edmonton’s disabled population to be calculated by age and gender cohort for the years 2001 and 2006.

3. Two data sets are insufficient to conduct a proper multivariable regression analysis between the age and gender profile of Edmonton’s total population and the number of disabled people residing within Edmonton.

   a. As a result, the explanatory power and co-relation between the age and gender profile of Edmonton’s total population and the number of disabled people residing within Edmonton could not be determined, but this relationship was still assumed to be linear.

4. Two data sets are insufficient to conduct multiple forecast methods for Edmonton’s disabled population by age and gender based on the forecast of Edmonton’s total population, and only allows a forecast by simple linear regression.

   a. As a result, only a simple linear regression was used to forecast Edmonton’s disabled population by age and gender based on the forecast of Edmonton’s total population.
5. DATS only tracks officially registered clients, and not also the people inquiring about its services.
   a. As a result, no indicator exists for the actual demand for DATS, but it was assumed that the number of officially registered clients could also serve as a surrogate indicator for this demand.

6. Two data sets are insufficient to conduct a proper multivariable regression analysis between the age and gender profile of Edmonton’s disabled population and the demand for DATS.
   a. As a result, the explanatory power and co-relation between the age and gender profile of Edmonton’s disabled population and the demand for DATS could not be determined, but this relationship was still assumed to be linear.

7. Two data sets are insufficient to conduct multiple forecast methods for the demand for DATS by age based on the forecast of Edmonton’s disabled population, and only allow a forecast by simple linear regression.
   a. As a result, only a simple linear regression was used to forecast the demand for DATS by age based on the forecast of Edmonton’s disabled population.

8. It was also assumed that:
   a. the exclusive driver of DATS’ total number of employees and vehicles, as well as its total operating expenses was its total number of clients;
   b. all other cost drivers are constant;
   c. decision makers will not intervene;
   d. productivity will not change; and
   e. DATS would indiscriminately and unconditionally accept all of its forecasted demand as clients.
VII. ANALYSIS

Analysis: Optimum Shift Design

In order to soundly interpret the results from our shift scheduling model, an intensive analysis of daily wheelchair demand was completed. Data was broken down into weekday and weekend demand numbers per quarter hour (Figure 3) to determine when operators were needed the most.

Figure 3: Weekday demand versus weekend demand

Based on this hourly demand profile for a typical day, our model showed that DATS’ current shift schedule experienced utilization rates that were relatively low, and fluctuated throughout the course of that same day. Average operator utilization for an average weekday was found to be 56%. It is interesting to see in Figure 4 that operator utilization exceeded 100% at certain times, which shows that demand is occasionally so great that operators cannot meet it within their service time. These spikes occur twice throughout the day (during DATS’ peak demand times), and then drop significantly thereafter. On the other hand, utilization dropped to 28% during the day at 16:30. With a high number of operators still working when demand is low, due to long operator shift lengths, it is now easy to understand why such a low utilization occurred.
To further the interpretation of our results, another analysis was completed on the constraints to DATS’ current shift schedule, which were largely due to supply issues. Since reducing operating costs is always an important goal, operator costs were dissected. As a city government owned, operated, and funded service, DATS’ resources are naturally limited with regards to their available fleet, FT and PT operators (Figure 5), and the shift lengths that are allowed under the current collective agreement. These limiting resources were compiled into performance indicators for our shift scheduling model, along with the hourly operator costs, and further analyzed in order to properly constrain our model while also satisfying DATS’ needs.

The numbers in Figure 5 show DATS’ minimal flexibility when building a shift schedule. If constraints are not met for a PT 60 and a PT 40 operator, they begin to qualify as a FT employee;
meaning they can then receive twice their pay when work is performed on a scheduled day off. As a result, it was determined that as more PT operators become available on staff, the more DATS will save on a daily basis. It is clear in Figure 6 that, on an average weekday, the current number of FT operators working during regular operating hours is significantly greater than the number of PT operators.

*Figure 6: FT and PT operators scheduled throughout the day*

Next, in order to objectively measure the benefits of other possible shift schedules, our shift scheduling model had to be able to demonstrate, in clear quantifiable financial terms, which of these schedules would incur lower / higher costs. An arbitrary wage rate of $20.53 per hour was assigned to all operators based on a weighted average of current wages paid (see Appendix 1). Our model was then built to test for various combinations of shifts, taking into account a multitude of different shift lengths and shift types.

DATS’ current shift lengths vary from 10, 8, and 5 hours (split shifts are also incorporated into their existing schedule). Of 88 operators scheduled daily, 62 are for 8 hour shifts, 17 are for 10 hour shifts, and 9 are for PT shifts (10.61% of DATS’ total operators are PT). The shift lengths that are allowed by the current collective agreement were not clearly outlined, except for when an operator is to receive OT pay. However, through discussions with DATS, we were able to deduce which shift lengths would be feasible. Any shift length less than 5 hours is usually not taken because of the time the operator spends on vehicle inspections, departures, and arrivals back at the depot. Shift lengths greater than 10 hours are not scheduled either because the quality of life
for the operators would most likely deteriorate due to the long consecutive work times in a relatively stressful environment.

The last analysis we completed through the course of interpreting the results from our shift scheduling model was a labour cost analysis, which enabled us to identify even more opportunities for improving DATS’ current shift schedule. This analysis involved determining the exact amounts of OT hours worked and paid between 2007 and 2008. We also identified and separated the different types of OT and pay according to their respective years (Figure 7). Since total OT costs increased by 35% between these years, and are already a major concern for DATS, we then performed a monthly analysis (Figure 8).

*Figure 7: Labour costs*

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Labour Costs</td>
<td>$5,800,000</td>
<td>$6,738,663</td>
</tr>
<tr>
<td>Total Overtime (OT)</td>
<td>$ 411,000</td>
<td>$ 636,000</td>
</tr>
<tr>
<td>Double Time (DT)</td>
<td>$ 356,000</td>
<td>$ 550,000</td>
</tr>
<tr>
<td>Time and One Half (TOH)</td>
<td>$ 55,000</td>
<td>$ 86,600</td>
</tr>
</tbody>
</table>

Figure 7 shows that the largest type of OT pay was double time (DT) in 2007 and 2008, and Figure 8 explains why.

*Figure 8: OT costs for 2007-2008*
OT fluctuated heavily for each month in both years. However, the months in their respective years are not heavily correlated to each other. This led to the important observation that there are no overriding OT trends. Instead, from these results, it appears that OT is due to specific yet random factors relating to driver availability (such as the unexpected illnesses of operators, which then requires DATS to replace these drivers at the DT rate), and not due to other factors or special events beyond statutory holidays (since these factors / events should reoccur in the following year, unless discontinued).

*Analysis: Demand Forecasting*

Table 1 (see Appendix 2) summarizes the forecasts for Edmonton’s total population, Edmonton’s disabled population, and the demand for DATS by the age and gender cohorts that are applicable to DATS based on the Base Case scenario. In addition, Table 1 summarizes the forecasts for DATS’ cumulative number of employees and vehicles, as well as its cumulative operating expenses based on the Base Case scenario.

An important trend to note (as depicted in Figure 9) is Edmonton’s moderate total population growth over the twenty year forecast period (17%) compared to its rapid 65 and over age group growth (93%).
This trend reveals an aggressive aging of Edmonton’s total population, which then aggressively influences Edmonton’s disabled population and, in turn, the demand for DATS. For example, during this forecast period, Edmonton’s total disabled population grows by 62%, while its 65 and over age group grows by 125% (as depicted in Figure 10).
As a result, the total demand for DATS grows by 234%, which is largely due to the growth in its 65 and over age group (442%) (as depicted in Figure 11).
As expected, such a large growth in the demand for DATS results in large growths in its number of employees (268%) and vehicles (215%), as well as its operating expenses (197%) (as depicted in Figures 12, 13, and 14, respectively).

*Figure 12: Forecast of the number of employees for the Base Case and High Scenario*
Figure 13: Forecast of the number of vehicles for the Base Case and High Scenario

![Graph showing the forecast of the number of vehicles for the Base Case and High Scenario.]

Figure 14: Forecast of the operating expenses for the Base Case and High Scenario

![Graph showing the forecast of the operating expenses for the Base Case and High Scenario.]

Table 2 (see Appendix 3) also summarizes the forecasts for Edmonton’s total population, Edmonton’s disabled population, and the demand for DATS by the age and gender cohorts that
are applicable to DATS, but based on the High Scenario. In addition, Table 2 also summarizes the forecasts for DATS’ cumulative number of employees and vehicles, as well as its cumulative operating expenses, but based on the High Scenario.

Similar to the Base Case, the important trend to note again is Edmonton’s moderate total population growth over the twenty year forecast period (29%) compared to its rapid 65 and over age group growth (99%) (see Figure 9).

Once again, this trend reveals an aggressive aging of Edmonton’s total population, which then aggressively influences Edmonton’s disabled population and, in turn, the demand for DATS. For example, during this forecast period, Edmonton’s total disabled population grows by 72%, while its 65 and over age group grows by 133% (see Figure 10).

As a result, the total demand for DATS grows by 256%, which, as in the Base Case, is largely due to the growth in its 65 and over age group (460%) (see Figure 11).

As expected yet again, such a large growth in the demand for DATS results in large growths in its number of employees (293%) and vehicles (235%), as well as its operating expenses (215%) (see Figures 12, 13, and 14).
VIII. DETAILED RESULTS AND BENEFITS

Detailed Results and Benefits: Optimum Shift Design

Due to all of the analyses that we completed on all of the results from our shift scheduling model, we are now able to make the following conclusions. First, however, it must be noted that DATS’ current shift schedule produces an average daily cost of $14,817.53. This figure has no OT costs associated with it. If OT is incurred, however, it can be added to this cost without affecting our conclusions since OT will act as a fixed cost for all shift schedules implemented.

Our first conclusion is that certain changes can be made immediately to DATS’ current shift schedule in order to improve the productivity of their operators. Figure 15 illustrates the daily cost savings for DATS if they implement minor changes to their current shift schedule (minor as in no additional trips being added, and, in some cases, just different placement of operators). It can be seen that there is a large opportunity for DATS to save on daily operator costs while still meeting the necessary level of demand.

Figure 15: Potential daily cost savings without the insertion of new tours

Our second, and major, conclusion is that greater flexibility in both start times and shift lengths results in increased cost savings. To capitalize on this phenomenon, DATS should adopt a greater
combination of FT to PT operators. The cost-benefit perspective of this adoption is depicted in Figure 16.

*Figure 16: Daily costs for different combinations of shifts*

<table>
<thead>
<tr>
<th>Varying Shift Schedules</th>
<th>62 8hr, 17 10hr, 9 PT</th>
<th>$14,607.29</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>$20,648.41</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>$19,226.54</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>$18,117.92</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>$17,912.62</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$16,434.46</td>
<td></td>
</tr>
<tr>
<td>8, 7, 6</td>
<td>$16,208.63</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>$16,023.86</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$15,202.66</td>
<td></td>
</tr>
<tr>
<td>10, 5</td>
<td>$15,202.66</td>
<td></td>
</tr>
<tr>
<td>Current Model</td>
<td>$14,817.53</td>
<td></td>
</tr>
<tr>
<td>12, 10, 8</td>
<td>$14,751.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10, 8, 5, 6 - 41PT</td>
<td>$13,724.50</td>
</tr>
</tbody>
</table>

With regards to greater flexibility in start times, when using the same number of operators and tours on DATS’ current shift schedule, but simply reallocating when these operators begin their shifts, daily cost savings of $210.24 are seen, as depicted in Figure 15 (that is, instead of three operators working from 06:00-14:00, two now work from 6:15-14:15). On almost all occasions, the greater the number of shift types available proved to be less expensive and more effective for DATS. With regards to greater flexibility in shift lengths, the most expensive system was a schedule built strictly on 7 hour shifts, while the most effective system was a schedule built on a mix of 10, 8, 6, and 5 hour shift lengths (Figure 16).

Alterations were then made to this shift schedule to determine what combination of FT and PT operators was optimal. Although costs continued to decrease as more PT operators were inputted into this shift schedule, it is highly unlikely that DATS will be able to actually employ 41 PT operators. Still, this approach provided valuable insights into how cost savings can be realized. For example, even the introduction of just eleven more PT in a workday will cut costs considerably.

Costs can also be cut by providing a greater selection of shift lengths throughout the day (Figure 17), which once again re-emphasizes the need for greater flexibility in shift lengths. Such a selection reduced the number of operators scheduled from 88 to 78. Further analysis showed that
with this reduction, DATS can then raise the wages of all the remaining operators by 3.92%, and still be within their current costs. This analysis also showed that the average utilization rate increased to 62% (as depicted in Figure 18), and did not drop as significantly or as frequently as in DATS’ current shift schedule, which then made the trend line not as steeply sloped as before.

Essentially, the productivity of operators now is smoother (that is, averaged) across the duration of a workday. This new shift schedule design adjusts to the peak hours that DATS faces, and more effectively schedules their operators.

*Figure 17: Varying combinations and results from a schedule built on 10, 8, 6, and 5 hour lengths*

<table>
<thead>
<tr>
<th>Shift Length</th>
<th>10</th>
<th>20</th>
<th>Unlimited</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>48</td>
<td>36</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>21</td>
<td>28</td>
<td>37</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>20</td>
<td>34</td>
</tr>
<tr>
<td><strong>Total Operators</strong></td>
<td><strong>78</strong></td>
<td><strong>84</strong></td>
<td><strong>94</strong></td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$14,258.28</strong></td>
<td><strong>$14,052.98</strong></td>
<td><strong>$13,724.50</strong></td>
</tr>
</tbody>
</table>

*Figure 18: Operator utilization rates with proposed schedule*


Having now completed all of the necessary tasks and measures in our attempts to accurately and reliably forecast DATS’ demand, we quickly realized that both scenarios forecast significant growth in this demand, which will drastically impact DATS’ ongoing operations. Consequently, it is essential that DATS effectively manages these potential impacts with cost containment strategies. As with all proposed strategies, each possesses advantages and disadvantages.

The most immediate and short term strategy to minimize the impacts of the forecasted demand for DATS on its total number of employees and vehicles, as well as its total operating expenses is to not accept all of this forecasted demand as clients. Instead, DATS can rationalize its number of clients based on very specific and highly selective admission criteria. Bases for such criteria may be to limit DATS to only the most severely disabled people, or to the most impoverished. DATS can then direct those disabled people not accepted as clients to other non-city organizations that also provide assisted transportation services. A cursory investigation into these organizations revealed three potential services: taxis, non-profit organizations / volunteer drivers, and private, for-profit companies (see Appendix 4). DATS can also lead an initiative to better accommodate more disabled people on the city’s regular transportation services, such as on ETS’ kneeling buses. While this strategy can be easily and quickly implemented, it will punitively disadvantage an already vulnerable population, which runs counter to the spirit and intrinsic intent of a public service.

Another strategy to minimize the impacts of the forecasted demand for DATS is to reduce its marginal employee costs. As demonstrated and articulated throughout the Optimum Shift Design section, such a reduction can be achieved by using a more optimal mix of both FT and PT operators in conjunction with a more optimal shift schedule. While this strategy can improve both client service and client satisfaction, it may disrupt the quality of life for DATS’ operators.

The last strategy is to reduce DATS’ marginal vehicle costs. Such reductions can be achieved by modifying DATS’ current approach of providing door to door service into a more centralized pickup and drop off service. This modification can be achieved by creating partnerships between DATS and other organizations that host regular and structured community programs or healthcare programs that are localized (see Appendix 5). It is the localization aspect of these programs that will allow DATS to centralize its service, and to realize cost savings. While this strategy can also
improve DATS’ wait and travel times, it may displease clients who expect and need door to door service. However, this displeasure may attenuate over time as these partnerships grow more robust, and create the capacity to accommodate more disabled people to more programs.
IX. RISKS

*Risks: Optimum Shift Design*

If DATS adopts a greater combination of FT to PT operators in order to realize the cost savings that result from greater flexibility in both start times and shift lengths, it will be exposed to three very specific and high level risks.

First, operators are paid for travel time to and from the depot. As a result, when shorter shifts are adopted, the time operators actually spend servicing clients may be very minimal. This will also result in a low utilization rate. While longer shifts will reduce low MDC_HRS logged and increase the efficiency of the shift scheduling system, these shifts will also increase costs. In addition, longer shifts increase the likelihood of OT because the hours logged throughout the week will accumulate. Second, any radical changes to the current shift schedule may adversely affect the quality of life for DATS’ operators, which, in turn, may spur additional adverse and unpredictable consequences. For example, the operator surveys (see Appendix 8) revealed that 85% of FT operators are already extremely satisfied with their current shift length, which, in turn, may then indicate their potential opposition to any new shift schedule that now emphasizes PT shifts. Third, the union may not be particularly receptive to these changes to the current shift schedule since these changes will reduce both shift lengths and OT. Such reluctance, however, may be offset by the possibility of raising operator wages while still allowing DATS to remain cost effective.

*Risks: Demand Forecasting*

The main risk associated with any forecast is its degree of variation, and the subsequent impacts of this variation. The city of Edmonton’s official forecast for Edmonton’s total population provides a broad and high level sensitivity analysis based on two scenarios: Base Case and High Scenario. These scenarios are defined within an economic context, which makes them somewhat coarse to use as the only basis for analyzing how variations in the forecasted demand for DATS
will change its impacts on DATS’ ongoing operations. As a result, for each scenario, an upper limit and lower limit of forecasted demand for DATS was calculated using the forecast’s standard error. These different forecasted demands were then used to calculate DATS’ total number of employees and vehicles, as well as its total operating expenses. The results of these calculations are summarized in Table 3 and Table 4 (see Appendix 6 and Appendix 7).

An important trend to note in both scenarios is the narrowing of the change (calculated as the range between the upper limit and lower limit expressed as a percent of the base) over the forecast period in the demand for DATS, its number of employees and vehicles, as well as its operating expenses (see Figures 19, 20, 21, 22). This narrowing can be partially explained by the increasing uncertainty, and error, of the forecast results in the later periods.

*Figure 19: Variations within the forecasted demand for DATS for the Base Case and High Scenario*
Figure 20: Variations within the forecasted number of employees for DATS for the Base Case and High Scenario

![Diagram showing variations in employees for DATS](image)

Average Range per Range in Demand = 1.08

Figure 21: Variations within the forecasted number of vehicles for DATS for the Base Case and High Scenario

![Diagram showing variations in vehicles for DATS](image)

Average Range per Range in Demand = 0.95
Another important trend to note in both scenarios is that a 1% variation in the forecasted demand for DATS results in average variations of 1.08% in its number of employees, 0.95% in its number of vehicles, and 0.90% in its operating expenses (see Figures 19, 20, 21, 22). This almost one to one ratio between demand and impact highlights DATS’ high sensitivity to variations in its demand, and, therefore, DATS’ need for caution when managing these impacts with the three proposed cost containment strategies.
X. IMPLEMENTATION AND NEXT STEPS

Implementation and Next Steps: Optimum Shift Design

While DATS’ current shift schedule is somewhat cost effective and productive, it can still be improved with the following recommendations.

Our first recommended improvement is to make varying tours available when scheduling operators. A shift schedule offering more ten hour shifts, as opposed to eight hour shifts, will reduce labour costs and should be implemented. Our second recommended improvement is to increase the number of PT operators. More PT operators will reduce OT costs since scheduling for absentees can now be managed without paying DT to operators (which is the largest driver of DATS’ OT costs).

If DATS is able to make varying tours available and increase their number of PT operators, then their organization will ultimately become even more cost effective and productive. These improvements may encourage the union to press for higher wages during the upcoming collective agreement negotiations. Thankfully, the costs saved as a result of this optimum shift design can offset the costs added as a result of these higher wages. In addition, this optimum shift design may have the potential to also be effective and productive from a quality of life perspective since, as revealed in the operator surveys (see Appendix 8), 38% of FT operators already perceive shorter shifts as improving their quality of life.

Implementation and Next Steps: Demand Forecasting

Despite the significant growth in demand for DATS resulting in significant impacts to its ongoing operations, and despite these impacts being sensitive to variations in this demand, DATS is still in an enviable position to effectively manage these significant and sensitive impacts. To now advance from this position, DATS should pursue the following next steps in relation to each cost containment strategy. Before such advancement can begin, however, DATS should, first, improve
its data quality by collecting demographic information on Edmonton’s disabled population, and on all people who inquire about its services.

First, to begin to investigate the possibility of not accepting all of the forecasted demand as clients, DATS should conduct a market analysis to identify all of the other non-city organizations that also provide assisted transportation services. Second, to begin to investigate the possibility of reducing its marginal employee costs, DATS should share the results from this optimum shift design project with its union as an introduction to a dialogue about accepting more PT work. Third, to begin to investigate the possibility of reducing its marginal vehicle costs, DATS should conduct a distribution analysis to identify the areas of the city where a majority of its clients are picked up and dropped off.
XI. REFERENCES

Alberta Sports and Recreation Association for the Blind, Goal Ball details retrieved from http://www.asrab.ab.ca/home.html


City of Edmonton, Senior Recreation and Sports Centers, Center descriptions retrieved from: http://www.edmonton.ca/attractions_recreation/sport_recreation/seniors_centres/northgate-lions-seniors-recrea.aspx


Human Resources and Skills Development, Various Programs/Funding for the Disabled retrieved from:


http://www.hrsdc.gc.ca/eng/disability_issues/


Services Canada, Various Programs for the Disabled, Canada Pension Plan Disability Vocational Rehabilitation Program retrieved from http://www.servicecanada.gc.ca/eng/audiences/disabilities/index.shtml
XII. APPENDICIES

Appendix 1:

Operator Wages

<table>
<thead>
<tr>
<th>Pay Rates</th>
<th>Wages for Employees</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Probationary (First 1,040 Hours)</td>
</tr>
<tr>
<td>Regular</td>
<td>$ 21.300</td>
</tr>
<tr>
<td>First 2 O.T Hrs Logged</td>
<td>$ 31.95</td>
</tr>
<tr>
<td>After 2 O.T Hrs Logged or Work Completed on Off Day</td>
<td>$ 42.60</td>
</tr>
<tr>
<td>or Statutory Holiday</td>
<td></td>
</tr>
<tr>
<td>Average Operator Wage</td>
<td>$ 20.53</td>
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### Appendix 2:

**Table 1 - Summary of the forecasted populations for the Base Case**

<table>
<thead>
<tr>
<th>POPULATION:</th>
<th>TOTAL POPULATION OF EDMONTON</th>
<th>GENDER:</th>
<th>male and female (total)</th>
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<tbody>
<tr>
<td>YEAR:</td>
<td>2010</td>
<td>2015</td>
<td>2020</td>
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<tr>
<td>AGE GROUP:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15 - 64</td>
<td>526,111</td>
<td>539,124</td>
<td>542,094</td>
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<tr>
<td>65 - over</td>
<td>96,339</td>
<td>115,034</td>
<td>137,636</td>
</tr>
<tr>
<td>TOTAL</td>
<td>622,450</td>
<td>654,158</td>
<td>679,730</td>
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</table>

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<th>POPULATION:</th>
<th>DISABLED POPULATION OF EDMONTON</th>
<th>GENDER:</th>
<th>male and female (total)</th>
</tr>
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<tbody>
<tr>
<td>YEAR:</td>
<td>2010</td>
<td>2015</td>
<td>2020</td>
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<tr>
<td>AGE GROUP:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15 - 64</td>
<td>60,902</td>
<td>63,985</td>
<td>65,649</td>
</tr>
<tr>
<td>65 - over</td>
<td>47,158</td>
<td>57,907</td>
<td>71,422</td>
</tr>
<tr>
<td>TOTAL</td>
<td>108,060</td>
<td>121,892</td>
<td>137,071</td>
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</table>

<table>
<thead>
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<th>POPULATION:</th>
<th>DEMAND FOR DATS</th>
<th>GENDER:</th>
<th>male and female (total)</th>
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<td>2010</td>
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<td>2020</td>
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<tr>
<td>AGE GROUP:</td>
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<tr>
<td>15 - 64</td>
<td>3,294</td>
<td>3,869</td>
<td>4,387</td>
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<td>65 - over</td>
<td>6,081</td>
<td>10,094</td>
<td>15,690</td>
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<td>TOTAL</td>
<td>9,250</td>
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<td>17,996</td>
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<tr>
<td>TOTAL OPERATING EXPENSES</td>
<td>$25,829,928</td>
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<tr>
<td>TOTAL DEDICATED VEHICLES</td>
<td>190</td>
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<tr>
<td>TOTAL FT AND PT EMPLOYEES</td>
<td>340</td>
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## Appendix 3:

### Table 2 - Summary of the forecasted populations for the High Scenario

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<tr>
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<td>2010</td>
<td>2015</td>
<td>2020</td>
<td>2025</td>
<td>2030</td>
<td></td>
</tr>
<tr>
<td>AGE GROUP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 - 64</td>
<td>528,511</td>
<td>557,905</td>
<td>578,496</td>
<td>595,345</td>
<td>616,073</td>
<td>17%</td>
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<tr>
<td>65 - over</td>
<td>96,497</td>
<td>116,337</td>
<td>140,305</td>
<td>168,459</td>
<td>192,071</td>
<td>99%</td>
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<td>TOTAL</td>
<td>625,008</td>
<td>674,242</td>
<td>718,801</td>
<td>763,804</td>
<td>808,144</td>
<td>29%</td>
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<td>AGE GROUP</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15 - 64</td>
<td>61,113</td>
<td>65,770</td>
<td>69,366</td>
<td>72,558</td>
<td>76,580</td>
<td>25%</td>
</tr>
<tr>
<td>65 - over</td>
<td>47,235</td>
<td>58,558</td>
<td>72,836</td>
<td>91,454</td>
<td>109,872</td>
<td>133%</td>
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<tr>
<td>TOTAL</td>
<td>108,348</td>
<td>124,328</td>
<td>142,202</td>
<td>164,013</td>
<td>186,452</td>
<td>72%</td>
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<td>2025</td>
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<tr>
<td>AGE GROUP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 - 64</td>
<td>3,306</td>
<td>3,976</td>
<td>4,636</td>
<td>5,311</td>
<td>6,093</td>
<td>84%</td>
</tr>
<tr>
<td>65 - over</td>
<td>6,091</td>
<td>10,208</td>
<td>16,001</td>
<td>24,240</td>
<td>34,106</td>
<td>460%</td>
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<td>TOTAL</td>
<td>9,275</td>
<td>13,483</td>
<td>18,670</td>
<td>25,280</td>
<td>32,998</td>
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<th></th>
<th>GROWTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL OPERATING EXPENSES</td>
<td>$25,887,737</td>
<td>$35,777,841</td>
<td>$47,968,066</td>
<td>$63,503,790</td>
<td>$81,642,870</td>
<td>215%</td>
</tr>
<tr>
<td>TOTAL DEDICATED VEHICLES</td>
<td>191</td>
<td>270</td>
<td>368</td>
<td>493</td>
<td>639</td>
<td>235%</td>
</tr>
<tr>
<td>TOTAL FT AND PT EMPLOYEES</td>
<td>341</td>
<td>518</td>
<td>737</td>
<td>1,015</td>
<td>1,341</td>
<td>293%</td>
</tr>
</tbody>
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Appendix 4:

Transportation Alternatives

This is a non-exhaustive list of existing transportation alternatives of the disabled population in Edmonton. These alternatives are somewhat competitors of Disabled Adult Transit Service (DATS). They both offer the same transportation service to the disabled (or in some cases, age as it is one of the main drivers of the disabled population).

One of the objectives of our group was to research the existing and future travel patterns of disabled people in the city and region. Currently, my research indicates that there are four different types of travel alternatives for the disabled.

1) Current DATS as well as ETS (kneeling buses)
2) Taxis
3) Non-profit organizations (volunteer drivers and other organizations)
4) Private companies (Driving Miss Daisy)

Here is a more in depth description of the before mentioned alternatives.

1) DATS as well as ETS (kneeling buses)

2) Taxis – Taxi Vans:

Checker Cabs

Service:

Offers group charter service (10 passenger vans).

Prices: Discounted price (Senior): $20.00/coupon package

Address: 10135 - 31 Avenue, Edmonton, AB T6N 1C2

Phone: 484-8888
Co-op Taxi Line Ltd.

**Service:** Offers specialized vans with wheel chair lifts, which can be booked a few hours ahead of time; however, to ensure a van they ask that you book 24 hours ahead.

**Prices:** There is a 10% discount on taxi coupons for seniors, which will be delivered to the customer’s door free of charge. For more information, contact Co-op Taxi.

**Address:** 10538 - 114 Street, Edmonton, AB T5H 3J7

**Contact:** Phone: 425-2525

Prestige Cabs

**Service:** Offer charter service (10 passenger vans). They also offer seniors’ discounts on coupons.

**Prices:** Discounted price (Senior): $20.00/coupon package

**Address:** 10135-31 Avenue, Edmonton, AB T6N 1C2

**Contact:** Phone: 462-4444

Yellow Cab

**Service:** Offers seniors discounts with coupons. Handicapped vans also are available; with the van service is provided outside of the city. Must call for van in advance.

**Prices:** There is a minimum charge of $10.00, plus the metered rate. $20.00/coupon package

**Address:** 10135-31 Avenue, Edmonton, AB T6N 1C2

**Contact:** Phone: 462-3456

3) Organizations Who Have Volunteer Drivers

Lifestyle Helping Hands Seniors Association

**Service:** They offer snow removal, lawn care, odd jobs, volunteer drivers, home cleaning, and outreach services.
Prices: Must be a member to access home help services & be matched with a worker. Membership is $10.

Contact: 780-450-2113

lhhsa@shaw.ca

Capital Health Home Care – Volunteer Driver Service

Service: Rides are provided to and from medical appointments for Home Care clients who are frail, elderly, or disabled.

Price: Must be a Home Care client receiving services. Candidates must be assessed by a “case manager” to see if they are eligible.

Contact: Phone: 496-1300

Senior Driving Center of Edmonton

Service: Volunteer drivers provide rides within the city limits. Information is first mailed out to clients and then someone is sent for an assessment. Not able to accommodate wheelchairs. Call 3 days in advance to book. Service is available Monday to Friday 8:30 a.m. to 4:30 p.m., up to two times a week.

Prices: $15.00 annual membership based on financial situation and assessment.

Address: Box 101, Room 2C221, 11111 Jasper Avenue, Edmonton, AB T5K 0L4

Contact: Phone: 732-1221

Fax: 732-1227

Helping Hands: Operation Friendship

Service: The service is for individuals who are not able to use the regular transportation system. They can drive anywhere in the city but you must live within the boundaries of Operation Friendship: 118th Avenue on the North, 101st Street on the West, the river on the South and 82nd Street on the East. You must book 2 to 3 days in advance. For those who are disabled, they do have a wheelchair van. You must be 55 years and older.
Prices: Two staff drivers are available to transport people to medical appointments or grocery shopping at no cost through the Helping Hands program.

Address: 9526-106 Avenue, Edmonton, AB T5H 0N2

Contact: Phone: 429-2626 Fax: 429-2626

E-Mail: opfriend@oanet.com

**Scona Drop In Centre (Senior Citizen Opportunity Neighbourhood Association)**

Service: A non-profit organization that offers rides free of charge to residents living on the Southside of Edmonton.

Prices: $5.00/year membership.

Contact: Phone: 433-5377

**Seniors Caring About Seniors**

Service: A non-profit organization that offers services to residents living on the Southside of Edmonton. In order to be eligible to use this service you must be a member, be over 60 years of age, and have a disability or frailty. For a minimal charge, Seniors Caring About Seniors offers alternative transportation, home and garden repairs, etc. Volunteer drivers will drive to destination anywhere in the city limits. They are NOT wheelchair equipped. Their hours of operations are Monday to Friday, 10:00 a.m. to 4:00 p.m. Rides are offered on a priority basis (1 – Medical, 2 – Health, 3 – Personal, 4 - Recreational).

Prices: $10.00/year memberships. Charge of $6.00 for 1½ hours.

Address: 8728-93Avenue, Edmonton, AB T6C 1T8

Contact: Phone: 465-0311

Fax: 465-7809

**4) Private companies:**

**Driving Miss Daisy**
Service: They offer transportation for seniors and also accompany and assist clients to their destinations. These destinations include to and from the doctor, shopping, to the hair salon and even to the airport. They assist with groceries and a personal shopper is also available (delivered). They are a safe and reliable transportation alternative, with reasonable rates and are wheelchair/walker friendly.

Prices: Prices vary. Average of $65/hour

Contact: Phone: 470-0123

Additional Info:

How many people use your service per day/month/year: There are 21 operational vehicles in the City of Edmonton and surrounding areas. I suspect that each vehicle performs between 6-12 services per day for seniors and those with disabilities.

To obtain service they can call a service provider directly or go through a centralized Call Centre to be put in touch with the service provider in the area where the client lives.

Do you have numbers on how many disabled people use your service? Difficult to answer but I would think that the majority of our services are provided to seniors and a smaller percentage to the disabled.
Appendix 5:

A report on existing and potential client groups based on disability type and attendance at various structured community-based and healthcare programs

The second Federal department partnership that we propose is to partner up with the Public Health Agency of Canada. This agency has as a mandate to promote and protect the health of Canadians through leadership, partnership, innovation and action in public health. There are two ways DATS can partner up with PHAC;

a) Program: “The Healthy Unit”

The Healthy Living Unit has the lead responsibility within the Public Health Agency of Canada to deliver on the federal government's role in physical activity promotion. The goals of the Healthy Living Unit are:

- To encourage and assist all Canadians to be physically active by increasing their awareness and understanding about the benefits of physical activity and the range of opportunities to be physically active in daily life\(^1\)

- To influence positive social and physical environments and opportunities that facilitate the integration of physical activity into daily life, and that are accessible to, and equitable for, all Canadians\(^1\)

- To establish partnerships with government and non-governmental agencies across levels and sectors, and encourage and support collaborative action and increased capacity to foster physical activity in Canada\(^1\)

Now the above-mentioned information was taken from the PHAC website and formulated targeted to the general population of Canada. However, we believe that if DATS was to approach PHAC and propose a possibility to mutually contribute to the “physical activity of Canadians”. This would be achieved by having, for example, specific days of the week where a recreational center would open its doors to the disabled population, and DATS would take care of all the transportation responsibilities involved. There are two facilities in Edmonton that would be perfect for such a program, the **Northgate Lions Seniors Recreation Centre** and the **Central Lions Seniors Association**. We will describe these centers in further detail in the section

\(^1\) PHAC, please view website in reference section
targeting Senior Recreational Centers as a potential partnership. Such a program would serve PHAC’s goal in promoting physical activity and the fact that it is targeted at a population segment (the disabled) that is not able and sometimes very limited to these types of opportunities for physical activity, this may result in leading them to offer some funding to promote DATS in order to allow these people who are interested in getting physical activity, the opportunity to do so.

b) Program: “Physical Activity and Healthy Eating Contribution Program”

The Physical Activity and Healthy Eating Contribution Program is an important part of the Public Health Agency of Canada’s mandate to help Canadians improve their health by doing regular physical activity and eating healthy. Recognizing that health is a shared responsibility, the PHAC is very supportive of offering contribution funding to support the voluntary act of eating and being healthy. That being said, this results in the PHAC being very open to creating partnerships between governments and non-government organizations. The purpose of this is to “help to reduce barriers and increase access to convenient, safe, affordable, and attractive opportunities to integrate physical activity and healthy eating into daily living”\(^2\).

Therefore, similarly to the previously mentioned program, DATS could approach the PHAC and suggest that in coordination with the “Physical Activity and Healthy Eating Contribution Program” they could create a program promoting the disabled population to be active by offering to bring them at the two above-mentioned Senior Recreational Centers. Now, the reason we suggest the Senior Recreational Centers is because due to the fact that one of the main indicators of disability is age, these centers would be most appropriate to host such programs. Although, factors and assumptions that must be taken into consideration are that there is most likely a large amount of the disabled people that are not able to perform much physical activity. Also, the recreational facilities may not be equipped with the appropriate physical fitness equipment that is required for disabled people. However, these centers were initially built for the senior population, therefore do possess adequate facilities and accessibility that will cater to the disabled.

Now stepping away from health and recreation sector, there are other ways in which the community requires the services of DATS, such as employment. We found that Human

\(^2\) PHAC, please view website in reference section
Resources and Skills Development Canada\textsuperscript{3} department offers various programs that cater to the needs of the disabled people, specifically attempting to offer employment opportunities.

Programs:

1) The \textbf{Enabling Accessibility Fund} supports community-based projects across Canada. It provides funding for projects that improve accessibility and enable Canadians, regardless of physical ability, to participate in and contribute to their communities and the economy.

If DATS could approach HRSDC with a potential project involving DATS offering their service of transporting people with disabilities to their respective jobs in Edmonton. Since HRSDC is offering support in trying to get disabled people that are willing and able to go back to work, DATS could possibly create an official and long-term partnership. For approved projects, HRSDC currently offers strong ties and support for the communities they serve. One of the only requirements is that the project must be in Canada and must identify a positive impact on people with disabilities. Therefore, for DATS this could be very plausible as it fits the description of DATS’ purpose. There are two types of funding that are available: periodically through Calls for Applications (grants) and Proposals (contributions).\textsuperscript{4} Though these programs are meant to be for individuals with small projects requiring small grants, there exists a potential that if properly communicated and proposed, HRSDC may be able to offer a wider range of funding. We believe that if HRSDC were to support DATS’ role in bringing disabled people to their places of work, this would benefit HRSDC’s service of helping disabled people regain or gain employment, perhaps even on a long-term basis.

2) \textbf{Opportunities Fund for Persons with Disabilities:}

The Opportunities Fund is a program designed to help people with disabilities prepare for and obtain employment or self-employment. It also assists people to develop the skills they need to keep a new job. Now the Opportunities Fund supports a variety of activities through partnership with organizations to help people with disabilities overcome the barriers they may face as they enter the job market.\textsuperscript{5}

\textsuperscript{3} HRSDC, please view website in reference section
\textsuperscript{4} HRSDC, disability issues, please view website in reference section
\textsuperscript{5} HRSDC, Disabled funding & programs, opportunities fund, please view website in reference section
These activities may include:

- Helping individuals start their own business;
- Helping individuals to increase their job skills;
- Helping individuals to integrate into the workplace through services that meet their special needs; and
- Encouraging employers to provide individuals with work opportunities and experience.

Now for the Opportunities Fund program, DATS has a potential to play a similar role as before mentioned in the first partnership proposal. The partnership between DATS and HRSDC would involve HRSDC recognizing the essential role that DATS plays in transporting the disabled people to their job. Consequently, creating additional/new funding to alleviate the costs of transporting these individuals.

**Partnership with Senior Recreational Centers:**

Another possible partnership that DATS could entertain is to create an agreement with senior recreation centers. Age being one of the principal factors that is correlated with disability, it would be beneficial to cater to these senior centers as they represent a large proportion of potential customers. DATS should specifically target these two centers; Northgate Lions Seniors Recreation Center and Central Lions Seniors Recreation Center. These centers are independent, non-profit organizations that were created to promote and provide opportunities for recreation, education and socializing, as well as to improve the well-being of adults 55 years of age and older. Perhaps the City of Edmonton, who currently has a unique collaboration with the Lion’s centers, could recognize the benefits of having DATS offering/organizing regular (advertised) transportation services that would pick up individuals and groups of disabled people to have them participate in specific events and programs that are offered at these centers. This would allow these individuals to participate in programs and activities that were perhaps not possible in the past due to mobility barriers. The City of Edmonton, already having a partnership with the Northgate and Central Seniors Recreation Centers, could see large benefits of adding DATS to this partnership.

Here are additional details regarding the two Senior Recreational and sports centers that was pulled from their website:
Northgate Lions Seniors Recreation Centre

7524 139 Ave

They provide over 200 programs, events, and services for seniors and the community.

Their Hours of Operation

Monday to Friday: 8:30am-4:30pm

Phone: 780-496-6969.

Their centre offers:

* Clubs
* Computer lab
* Crafts, arts and hobbies
* Fitness and sports
* Health and wellness
* Music, song and dance
* Social and educational experiences
* Community evening and weekend programs

Their 48,000 sq. ft. facility has:

* A large gymnasium (capacity 400)
* Cafeteria
* Boardroom
* Six multi-purpose rooms
* Rooms for snooker, woodworking, pottery, lapidary
* Fitness Centre
* Parking

For more information:

Telephone: 780-496-6969

AND

**Central Lions Seniors Association**

11113 113 Street

They provide a variety of programs and services for seniors and other members of the community.

**Hours of Operation:** Monday to Friday 8:30am-4:30pm

**Their centre offers:**

* Fitness and sport
* Health and wellness
* Crafts and hobbies
* Music and dance
* Computers
* Art
* Games
* General learning

**Their 70,000 sq. ft. facility has:**

* A large auditorium (capacity: 350)
* Fifteen multi-purpose activity rooms
* Boardroom and meeting rooms
* Activity rooms, art and vocational classrooms
* Fitness studio and weight room with senior-friendly equipment

* Gymnasium

* Atrium and social areas

* Cafeteria, operated by Reflections by Shelley, home-cooked meals made from scratch

Telephone: 780-496-7369

Fax: 780-442-0946

**Partnerships with Disability Organizations and Associations:**

Finally, another potential client group that has specific programs in which DATS could associate with are the Canadian National Institute for the Blind (CNIB) and/or the Alberta Sports and Recreation Association for the Blind.

The **Alberta Sports and Recreation Association for the Blind** is an association that is dedicated to the provision of recreation and sports opportunities for Albertans who are blind and partially sighted.

- **Get Together for Goal Ball!**

  *Goalball is a fast-paced Paralympic sport developed uniquely for blind and visually impaired athletes. Contact Carrie at (780) 454-3763 for information about upcoming opportunities for young people 14 years of age and older.*

This partnership between The Alberta Sports and Recreation Association for the Blind and DATS would have as a main objective to offer the service of transporting disabled people to recreational centers and events. This would not necessarily be for financial gains but rather to enable this disability type to participate in recreational activities.

The **Canadian National Institute for the Blind (CNIB)** is an organization that if a partnership was to be created, may serve as a gateway to serve the blind community of Edmonton. The CNIB organizes a multitude of activities in which DATS could offer their transportation service in order to enable disabled participants to partake in these activities. This would be a great way to

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6 ASRAB, please view website in reference section
accomplish two main things, to cater to the blind people of Edmonton as well as inform people who have never heard of DATS, of the services available in the city of Edmonton.

Here are some of the activities that DATS could look at:

(These were taken from their website\(^7\))

- **Leisure Opportunities for Persons with Special Needs**

  *To receive a copy of this guide developed by the City of Edmonton or for information about leisure and recreation opportunities, call (780) 496-4917.*

- **Paralympic Sports Association**

  *Exciting recreation opportunities exist for young people with disabilities. Call (780) 439-8687 for more information.*

- **Bowl with the Edmonton Fantastix!**

  *Canadian Council for the Blind invites you to join them Tuesdays 3:30 p.m. at Bonnie Doon Lanes. Contact Wendie Brandle (780) 468-7021*

- **Curling For People With Vision Loss**

  *Curl at the Granite Curling Club, 8620 – 107 St., all winter long. Saturdays at 4. Contact Rose Barber (780) 484-1911*

- **Attention all Fishers!**

  *The annual Fishing Derby is organized by the Alberta Fish and Game Association. Contact CNIB in late April for registration (780) 488-4871*

For these programs/events, it could be possible for DATS to be an authorized transportation service. The individuals participating in these events may not be “registered DATS” clients, but if DATS wanted to make exceptions to use DATS in these specific events, than they could be able to cater to the blind. Financial compensations may not be present, but it would be an opportunity to serve the disabled community and perhaps inform some disabled people on the services of DATS.

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\(^7\) CNIB, please view website in reference section
Determine DATS effectiveness in serving each segment

Having identified the different types of disability, as well as certain programs in which these disabled people are prone to attending, we can now attempt to determine the effectiveness in serving each segment. For the scope of this project, we will only observe these 3 categories:

1) The blind or visually impaired

2) The physically disabled (mobility) that are looking to get physically active

3) The disabled people (all categories) who are able and willing to re-infiltrate the workforce

Let’s start with DATS’ effectiveness in serving the blind and visually impaired segment. In order to measure effectiveness for the blind, we have to identify what would lead to satisfaction for blind people in using DATS’ service. The first measure would be availability, in other words is the transportation service readily available for this disability type. The first thing to observe is to determine if people who are visually impaired qualify for DATS service at the same rate as other disability types. If there are discrepancies in the proportions, these differences should be analyzed and the reasoning identified. The second measure of effectiveness shall be to determine the ease that exists in blind people in physically using DATS’ service. Are there direct or indirect barriers that are due being visually impaired that limit or challenge the use of DATS transportation service? In order for this disabled segment to effectively be served, these two measures should be examined.

The second category that we will attempt to measure the effectiveness in serving is the segment of the physically disabled people who want to be physically active. This segment, just as any other population segment, is one that wishes to improve their health by remaining active. In order to measure DATS’ effectiveness at serving this highly specific segment, we have to think what do typical commuters wish while going to the gym. Some may say that availability is the most important measure, ensuring the transportation service that will bring these individuals to the recreational centers is readily available for whenever these individuals wish to attend the centers. Are there long wait times? The second measure would be the amount of luggage space on the buses transporting these individuals to the centers. People who frequent the gym most likely have gym bags and require additional room for their bags. Therefore, the buses must not be overcrowded in order to allow these individuals to feel at ease.
The third category in which we will measure DATS effectiveness in serving the segment is the category of the disabled people who are able and willing to join the workforce.

The first measure is, as mentioned numerous times already, availability. Typical people who are actively working know that if they have no means of transportation to go to work, then they cannot go to work. And if their transportation is not readily available to bring them to work, then once again, they cannot successfully join the workforce. Another crucial element is if the transportation service is not available at the required time, then the individual will not be able to go to work on time. The second measure is reliability, in other words to be able to consistently go to work on a regular basis. If the transportation service cannot offer the service and perform on a regular basis, as most employers have fixed operating hours, then the individual cannot successfully join the workforce. Reliability is very important for employers, therefore is crucial for the disabled individuals who want to work.

This concludes the report on the existing and potential client groups based especially on disability type as well as attendance at various structured community-based and healthcare programs. We have defined the specifics of the disability types, as well as explored many potential partnerships that will allow DATS’ to further serve the disabled population, as well as potentially create financial ties with these organizations.
Appendix 6:

Table 3- Summary of the sensitivity analysis for the Base Case

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>TOTAL (upper limit)</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>GROWTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>POPULATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GENDER: male and female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YEAR:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>11,391</td>
<td>15,662</td>
<td>20,373</td>
<td>25,614</td>
<td>31,203</td>
<td>174%</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>9,250</td>
<td>13,219</td>
<td>17,996</td>
<td>24,021</td>
<td>30,887</td>
<td>234%</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>7,350</td>
<td>10,959</td>
<td>15,290</td>
<td>20,436</td>
<td>26,278</td>
<td>258%</td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHANGE</td>
<td>44%</td>
<td>36%</td>
<td>28%</td>
<td>22%</td>
<td>16%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CUMULATIVE IMPACT

| TOTAL OPERATING EXPENSES (upper limit) | $30,862,646 | $40,898,479 | $51,971,233 | $64,288,076 | $77,422,949 | 151%  |
| TOTAL OPERATING EXPENSES (lower limit) | $25,829,928 | $35,157,003 | $46,385,011 | $60,543,770 | $76,681,892 | 197%  |
| TOTAL OPERATING EXPENSES (average)    | $21,363,930 | $29,845,832 | $40,024,355 | $52,119,886 | $65,848,732 | 208%  |
| CHANGE OF OPERATING EXPENSES PER CHANGE OF AGE GROUP | 0.84 | 0.88 | 0.91 | 0.93 | 0.95 |
| average                          | 0.90                  |

| TOTAL DEDICATED VEHICLES (upper limit) | 230           | 311           | 400           | 499           | 605           | 162%  |
| TOTAL DEDICATED VEHICLES (lower limit) | 154           | 222           | 304           | 401           | 512           | 232%  |
| TOTAL DEDICATED VEHICLES (average)    | 190           | 265           | 355           | 469           | 599           | 215%  |
| CHANGE OF DEDICATED VEHICLES PER CHANGE OF AGE GROUP | 0.92 | 0.94 | 0.96 | 0.97 | 0.97 |
| average                          | 0.95                  |

| TOTAL FT AND PT EMPLOYEES (upper limit) | 430           | 610           | 809           | 1,029         | 1,265         | 194%  |
| TOTAL FT AND PT EMPLOYEES (lower limit) | 260           | 412           | 594           | 811           | 1,057         | 307%  |
| TOTAL FT AND PT EMPLOYEES (average)    | 340           | 507           | 708           | 962           | 1,252         | 268%  |
| CHANGE OF FT AND PT EMPLOYEES PER CHANGE OF AGE GROUP | 1.15 | 1.10 | 1.07 | 1.05 | 1.04 |
| average                          | 1.08                  |
#### Appendix 7:

**Table 4- Summary of the sensitivity analysis for the High Scenario**

<table>
<thead>
<tr>
<th>POPULATION:</th>
<th>DEMAND FOR DATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENDER: male and female (total)</td>
<td></td>
</tr>
<tr>
<td>YEAR:</td>
<td>2010</td>
</tr>
<tr>
<td>AGE GROUP</td>
<td></td>
</tr>
<tr>
<td>TOTAL (upper limit)</td>
<td>11,438</td>
</tr>
<tr>
<td>TOTAL</td>
<td>9,275</td>
</tr>
<tr>
<td>TOTAL (lower limit)</td>
<td>7,380</td>
</tr>
<tr>
<td>CHANGE</td>
<td>44%</td>
</tr>
</tbody>
</table>

**CUMULATIVE IMPACT**

| TOTAL OPERATING EXPENSES (upper limit) | $30,972,383 | $42,041,726 | $54,803,692 | $69,512,237 | $85,780,479 | 177% |
| TOTAL OPERATING EXPENSES (lower limit) | $25,887,737 | $35,777,841 | $47,968,066 | $63,503,790 | $81,642,870 | 215% |
| TOTAL OPERATING EXPENSES (lower limit) | $21,434,732 | $30,645,786 | $42,150,077 | $56,288,046 | $72,887,173 | 240% |
| CHANGE | 37% | 32% | 26% | 21% | 17% | |
| CHANGE OF OPERATING EXPENSES PER CHANGE OF AGE GROUP | 0.84 | 0.89 | 0.91 | 0.94 | 0.95 | average 0.91 |

| TOTAL DEDICATED VEHICLES (upper limit) | 231 | 320 | 423 | 541 | 672 | 190% |
| TOTAL DEDICATED VEHICLES | 191 | 270 | 368 | 493 | 639 | 235% |
| TOTAL DEDICATED VEHICLES (lower limit) | 155 | 229 | 321 | 435 | 568 | 267% |
| CHANGE | 40% | 34% | 28% | 22% | 16% | |
| CHANGE OF DEDICATED VEHICLES PER CHANGE OF AGE GROUP | 0.92 | 0.94 | 0.96 | 0.97 | 0.98 | average 0.95 |

| TOTAL FT AND PT EMPLOYEES (upper limit) | 432 | 631 | 859 | 1,123 | 1,415 | 227% |
| TOTAL FT AND PT EMPLOYEES | 341 | 518 | 737 | 1,015 | 1,341 | 293% |
| TOTAL FT AND PT EMPLOYEES (lower limit) | 261 | 426 | 632 | 886 | 1,184 | 353% |
| CHANGE | 50% | 39% | 31% | 23% | 17% | |
| CHANGE OF FT AND PT EMPLOYEES PER CHANGE OF AGE GROUP | 1.15 | 1.10 | 1.07 | 1.05 | 1.04 | average 1.08 |
Appendix 8:

Summary of the Operator Survey

Survey size: 18 operators

Full time: 13
Part time: 5

From a perspective on improving your quality of life at work:

Q1: I would consider to work shorter shift lengths if possible

For FT: 38% of FT employees agreed, 23% disagreed, and 38% strongly disagreed.

For PT: 80% of PT employees disagreed, and 20% disagreed.

Interpretations: Our first objective was to find out employees’ thoughts on changing their shift lengths. We found that 38% of full time employees believed that shorter shifts would lead to improve their quality of life. We also found that 38% disagreed with this statement. On the other hand, part time employees were apposed to work shorter shifts, having 80% of respondents disagree and 20% strongly disagree. Therefore, our interpretation of these results was that full time employees are more likely to consider shorter shifts than part time employees. This was predicted as PT employees already work short shifts, therefore cannot shorten their shifts.

Q2: I would consider working longer shift lengths if possible

For FT: 23% said they agreed, 23% said they disagreed. 48% of FT employees strongly disagreed.

For PT: 20% said they strongly agreed, 60% said they agreed, and 20% said they disagreed.

Interpretations: The average response from full time employees regarding the consideration of longer shifts was found to be negative, having 23% of them disagree and 48% strongly disagree. On the other hand, part time employees were found to be much more open to the idea of having longer shifts, having 20% of them strongly agree and an enormous 60% agree. This indicates and supports our initial prediction, that part time employees are more likely to be open to increase the shift hours if need be.
Q3: I am satisfied with my current shift length

For FT: 15% said they strongly agreed, and 85% said they agreed.

For PT: 100% said they agree, therefore are satisfied with their shift hours.

Interpretations: Now regarding the satisfaction level of employees’ current shift lengths, we found that 85% of full time employees were happy with their shifts. Another important statistic that should be mentioned is that all part time employees agreed to say they were satisfied with their shift length. This is a clear indicator that the current part time initiative that DATS has undertaken is being well received. Therefore, a potential increase in part time shifts in the near future may be well received from the employees as it already seems to do well.

In terms of flexibility:

Q4: Overtime hours are very appealing to me

For FT: 38% of FT employees said they agreed and 38% said they disagreed.

For PT: 40% said they strongly agreed. 40% said they agreed. 20% said they disagreed.

Interpretations: For the full time employee segment that was surveyed, the general response towards the appeal of over time hours was neutral, the results did not incline to either side. We found that 38% of these employees indicated that they agreed and 38% indicated that they disagreed. We believe that the reasoning for this is that overtime does not appealing to all employees. Some employees prioritise their families or other personal factors. On the other hand, our survey also found that the part time employees were more prone to strongly agree (40%) or agree (40%) with the statement of overtime appealing to them. This is most likely due to part time employees most likely wanting to work additional hours.

Q5: It’s relatively simple to switch shifts or get my shift covered

For FT: 23% said they agreed, 23% said they disagreed and 54% said they strongly disagreed.

For PT: 40% said they agreed, 20% said they disagreed. 40% said they strongly disagreed.

Interpretations: Regarding the ease that employees have in switching shifts or getting a specific shift covered due to unexpected circumstances, 23% of full time employees disagreed and 54% strongly disagreed. This indicates that it is either hard and/or cumbersome to perform this task.
Part time employees also seemed to have difficulty in switching a shift as 40% of them indicated that they strongly disagreed.

**In terms of productivity:**

Q6: My utilization is very high. That is, I am working efficiently

For FT: 46% said they agreed. 31% said they disagreed.

For PT: 80% said they strongly agreed and 20% said they agreed.

*Interpretations:* Our survey found that part time employees showed a greater self-perception of their utilization/efficient rate, having 80% strongly agree and 20% agree. In comparison, full time employees only indicated that 46% of them agreed with this statement and 31% disagreed. An interpretation of this is that the part time employees are mainly scheduled to work during peak demand periods, resulting in a greater rate of utilization.

Q7: I spend little time waiting for clients during pick-ups

For FT: 69% said they agreed and 31% said they disagreed.

For PT: 20% said they strongly agreed. 60% said they agreed. 20% said they disagree.

*Interpretations:* Both full time and part time employees indicated that they spend little time waiting for clients, 69% of full time and 60% of part time employees agreed with this statement. This is a clear indicator that, according to the operators’, there is no loss in productivity that would exist from having to wait for clients.

Q8: DATS employs too many operators to perform pick-ups at one time

For FT: 23% said they strongly agreed. 31% said they agreed. 31% said they disagreed.

For PT: 20% said they agreed. 60% said they disagreed. 20% said they strongly disagreed.

*Interpretations:* For full time employees, their responses indicate that they believe there is too many operators that are scheduled at one time, having 23% strongly agree and 31% agree. The part time employees on the other hand showed to be on the other end of the spectrum. The part time employees had similar results, having 60% disagree and 20% strongly disagree. Once again, this may be due to part time employees currently being scheduled to cover peak periods of demands.
**My current tasks at work:**

**Q9: Are often overwhelming**

For FT: 38% said they agreed. 54% said they disagreed.

For PT: 60% said they agreed. 40% said they disagreed.

*Interpretations:* The statement suggesting that work is overwhelming was perceived by full time employees as false. The majority indicated that they disagree (54%), therefore suggesting that their workload is manageable. The part time employees showed different results, having 60% of these employees agree with this statement suggesting that their current tasks at work are overwhelming. Once again, this may be due to part time employees currently being scheduled to cover peak periods of demand.

**Q10: Make me feel pressured and stressed to deliver on time**

For FT: 31% said they strongly agreed. 46% said the agreed and 23% said they disagreed.

For PT: 20% said they strongly agreed. 60% said they agreed and 20% said they disagreed.

*Interpretations:* For the question relating to workload resulting in employees feeling pressured and stressed, we found that both full time and part time employees feel pressured and stressed. For the full time employees, 31% strongly agreed and 46% agreed with this statement. Similar results were found for the part time employees showing that 20% strongly agreed and 60% agreed. Further research should be done to find out where and when this stress is occurring. However, our predictions indicate that it will most likely be found in peak demand periods, which can be solved by having a readily available pool of part time employees to pull from in such periods.

**Q11: Are reduced substantially outside of peak pick-up times**

For FT: 69% said they agreed. 31% said they disagreed.

For PT: 60% said they agreed. 40% said they disagreed.

*Interpretations:* For our question relating to workload being substantially lower outside of peak demand periods, the majority of employees agreed with this statement. More specifically, we found that 69% of full time employees and 60% of part time employees believed this was true.
Qualitative research (sample responses):

Q12: What changes could be made to the current shift schedule

For FT:

- Implement better system to have a replacement bus up and going in case of breakdown or accident.
- More three and four day weekends.
- More full time shifts for peak hours, not enough people to do work. Also, 3 hour split shifts are a waste of time.
- Increase in variety for shift lengths. Would be interested in different combinations of 5, 6, and 8 hour shifts.

For PT:

- Return to floating breaks.
- Longer part time shifts.
- Facilitate the ability to switch/trade shifts for part time employees.
- More breaks during shift for washroom breaks.

Q13: Rate your overall quality of life at the workplace

For FT: Our survey found that the average score on a scale of one to ten, (1 being the lowest level of quality of life) was a 6.

For PT: The average score was a 7.2.

Interpretation: From this statistic, we gather that part time operators indicate a greater satisfaction in their job, leading to a better quality of life.

Q14: What would you change to increase overall quality of life

For FT:

- Better organization of trips, less backtracking.
• Acquire fuel-efficient buses.

• We drive, drive and drive. Leads to burnout. Reduce turnover by solving this.

• Have more washroom breaks.

• Same shift start times for relief drivers.

• Reduce workload, resulting in less stress.

• Better scheduling.

• Management should treat drivers like human beings. The expectations of drivers having to make-up for a shortfall of drivers and unexpected increase demand are unrealistic.

• Workplace is far too stressed. Operators are being pushed far beyond limit.

• Better communication system. Hard to hear and understand what other drivers are saying when requesting for help. MDT too awkward and distracting.

For PT:

• Facilitate the ability to switch/trade shifts for part time employees.

• Eliminate shifts that are too tight (from shift start to shift end).

• Improve efficiency of trip transfer.

• More pre-trip inspection time during the winter.

• DATS is doing a great job, wouldn’t change anything.
Appendix 9:

Shift Scheduling Model User Manual

**Shift Scheduling Model User Manual:**

1. Open Excel Workbook titled Shift Schedule.

2. Install QTP if not already installed. (See Appendix 10).

3. Insert type of available tours into fields directly above row containing “Demand” in the worksheet “Model Layout”. Easiest way to do so, is to copy the entire desired shift length rows chosen from available worksheets and to insert copied cells.

4. Adjust range of “FT Operators Scheduled”, “PT Operators Scheduled”, and “Total Daily Cost” to take into account all shift types added into the model.

5. Change average wage if applicable


7. a. Target Cell should be the cell containing “Total Daily Cost”.

   b. Select “Min”.

   c. Changing cells are values inside the “Assigned” column.

   d. Constraints: “Total Operators Scheduled” >= “Operators Required”

      : Changing cells = integer

8. Under options check off assume linear model, use automatic scaling and assume non-negative. Precision = 0.000001. Tolerance = 1%. Iterations = 200

9. Select Solve.

10. View and analyze changes made by model.

Provided in the workbook are copies of the existing shift schedule along with the one we recommend.
Appendix 10:

Queuing ToolPak

**Queuing ToolPak (QTP) v4.0+:**

The Queuing ToolPak (QTP) is a Microsoft Excel add-in consisting of a library of functions that perform basic calculations for waiting line analysis. Once the Queuing ToolPak is installed on your computer you can use the functions as you would any other Excel function. The functions allow integration of queuing performance measures into spreadsheet models without the limitations imposed by templates with fixed input and output areas that are commonly used for analysis of waiting lines. The following link provides general info on QTP add-in:

http://www.bus.ualberta.ca/aingolfsson/qtp/default.htm

Getting QTP add-in to work on your computer involves two steps: downloading the add-in files to your computer and loading the add-in in Excel. For detailed instructions on how to download the add-in to your computer and how to load the add-in in Excel, visit:

http://www.bus.ualberta.ca/aingolfsson/qtp/download.htm

**Downloading QTP 4.0:**

Queuing ToolPak 4.0 has been tested with Windows 2000 and Windows XP, with Excel 2000 and Excel XP. The Queuing ToolPak may or may not work on other platforms. Compatible with 2007 as well.

1. Open qtp.exe to a folder of your choice off data disc provided.

2. Double-click qtp.exe. Click "OK" and then "Unzip." This will "unzip" the files necessary for the Queuing ToolPak to work and copy them to your hard disk. By default, the files are copied to C:\QTP\ but you can change the folder if you wish. Click "Close."

**Loading QTP 4.0:**

1. To load QTP 4.0, open Excel and choose "add-ins ..." from the "tools" menu. Click the browse button, browse to the folder that you unzipped the QTP files to (C:\QTP\ by default), select qtp.xll and click "OK." Click "OK" again. The message below should appear indicating that the Queuing ToolPak has been loaded. Click "OK."
2. To verify that the Queuing ToolPak has been loaded correctly, look for a new QTP menu and choose help from that menu. As well, open the function wizard and look for a new function category for "Queuing ToolPak."

3. You are now ready to use the Queuing ToolPak. The help file contains a tutorial that can help get you started.

*All above information obtained from the University of Alberta School of Business. Developed by Professor Armann Ingolfsson.*