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| Relocation, relocation, relocation – A report for 311 on the cost of Asbestos Remediation in Downtown Toronto  2019 |
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| December 16  Coursera Capstone  Authored by: Carol Sutton |

# Executive Summary

The City of Toronto is aware that some of the buildings in a number of areas (namely those near Downtown Toronto) may have been built using asbestos[[1]](#footnote-1).

Venues that need to be relocated will be given access to the data to help them relocate into an area that provides them with good business opportunities. The City of Toronto has commissioned this report to provide direction and guidance to the Senior Leadership Group on the implications of the discovery of the hazardous materials. Stakeholders directed that Etobicoke be considered as the primary location neighbourhood. Subsequent analysis identified that the borough of Queens Park contained buildings that were unlikely to be contaminated due to their average, and may be suitable to relocate a small number of venues.

Analysing the number of venues, the relocation and remediation costs for each as well as undertaking a liability assessment for not undertaking any relocation or remediation work this report has shown that the most cost-effective solution is to relocate everybody to either Etobicoke or Queens Park. This could cost $(C) 45,568,000 that has not been budgeted for. Large as this figure is, it represent less than 1% of the potential liability cost of not relocating the venues.

Only relocating a subset of venues that have no competition in these areas would reduce the relocation costs alone; the remediation and liability costs would remain the same as remediation needs to take place on affected buildings. The nature of asbestos is that it affects everyone and therefore even if 40% of the venues were to be relocated, everyone could be entitled to compensation.

# Table of Contents

[Executive Summary 2](#_Toc27388064)

[Table of Contents 3](#_Toc27388065)

[Introduction 5](#_Toc27388066)

[CRISP – DM Methodology 6](#_Toc27388067)

[ Business Understanding 6](#_Toc27388068)

[o Analytical Approach 6](#_Toc27388069)

[o Data Requirements 6](#_Toc27388070)

[o Data Collection 7](#_Toc27388071)

[ Data Understanding 7](#_Toc27388072)

[ Data Preparation 7](#_Toc27388073)

[ Modelling 8](#_Toc27388074)

[Results 9](#_Toc27388075)

[ Toronto 9](#_Toc27388076)

[ Downtown, Midtown and Uptown 9](#_Toc27388077)

[ Etobicoke 11](#_Toc27388078)

[ Queens Park 12](#_Toc27388079)

[ Cost Data 12](#_Toc27388080)

[o Moving Costs 12](#_Toc27388081)

[o Hazardous Material Remediation Costs 13](#_Toc27388082)

[o Settlement Costs in Asbestos Liability Cases 13](#_Toc27388083)

[o Other Compensation arrangements 13](#_Toc27388084)

[ Population Data 13](#_Toc27388085)

[Discussion - Two Neighbourhoods and a Borough 14](#_Toc27388086)

[ Venue profiles 14](#_Toc27388087)

[ Relocation Cost Profiles 16](#_Toc27388088)

[o Relocating all the venues in the affected area 16](#_Toc27388089)

[o Relocating those venues with no competition 17](#_Toc27388090)

[ Cost of compensation and other liabilities 17](#_Toc27388091)

[o Compensation for the whole affected area 17](#_Toc27388092)

[ One-off costs 17](#_Toc27388093)

[ Ongoing costs 17](#_Toc27388094)

[ Cost and liability profiles 18](#_Toc27388095)

[o Relocating all the venues 18](#_Toc27388096)

[o Relocating 40% of the venues 18](#_Toc27388097)

[ Total Cost and liability comparison for both option 19](#_Toc27388098)

[Conclusions 20](#_Toc27388099)

[Assumptions 21](#_Toc27388100)

[References 22](#_Toc27388101)

# Introduction

311 provides residents, businesses and visitors with easy access to non-emergency City services, programs and information 24 hours a day, seven days a week. (City of Toronto, 2019).

The City of Toronto has been made aware that some of the buildings in a number of areas (namely those near Downtown Toronto) may have been built using asbestos[[2]](#footnote-2).

As a service to residents, 311 is offering to identify relocation areas for current residents that are similar to the ones that they live in currently (obviously without the buried hazardous material). Subsequent relocation would be free for those residents whose housing is provided by the City of Toronto. Other residents needing to be relocated will have their expenses subsidized. A separate report has been commissioned by 311 to determine the impact of relocating the residents.

Businesses that need to be relocated will be given access to the data to help them relocate into an area that provides them with good business opportunities. 311 commissioned this report to provide direction and guidance to the Senior Leadership Group on the financial implications of the discovery of the hazardous materials. Stakeholders directed that Etobicoke be considered as the primary location neighbourhood. Subsequent analysis identified that Queens Park contained buildings that were unlikely to be contaminated due to their average.

This report covers the following sections:

* The Methodology used (CRISP – DM Methodology),
* Results,
* Discussions – Two Neighbourhoods and a Borough
* Conclusions,
* Assumptions, and
* References.

# CRISP – DM Methodology

## Business Understanding

## Analytical Approach

*“The CRISP-DM methodology is a process aimed at increasing the use of data mining over a wide variety of business applications and industries. The intent is to take case specific scenarios and general behaviors to make them domain neutral.”* (IBM Knowledge Center, 2019). Using the first four steps of the CRISP-DM six steps process, shown in Figure 1, this report will provide direction and guidance to the Senior Leadership Group on the financial implications of the discovery of the hazardous materials.



Figure - CRISP-DM model, IBM Knowledge Center, CRISP-DM Help Overview

## Data Requirements

In discussions with the stakeholders at 311, it was determined that the following types of data would be most useful for this activity, specifically on the:

* types of businesses in the areas to be relocated,
* locations of those businesses,
* types of business in the areas that are considered suitable for relocation to, and
* locations of the business in the new areas.

## Data Collection

Much of the data required for this analysis was open source data, mainly sourced from the internet. This included for the data on the:

* City of Toronto (Wikimedia Foundation Inc, 2019),
* Asbestos Removal Costs (Canada's Restoration Services, 2019), and
* Moving Costs in Canada (Green, 2019).

The latitude and longitude data of each neighbourhood was provided by 311 from the following location - <http://cocl.us/Geospatial_data> (311 (aka Coursera), 2019).

## Data Understanding

During this phase, the agreed data set was reviewed to see if it would provide the required information. This review involved creating some initial tables, graphs and maps.

As well as determining the relevance of the information, this review provided an opportunity to ensure that the data sets were both complete and accurate. Accuracy was restricted to confirming that the data was relevant to Toronto.

## Data Preparation

*‘It's the preparation that's my favourite part of the process.’*

*Ruth Wilson (1982 - )* (Brainy Quote, 2019)

This step consumed the most scheduled time as the following activities were undertaken:

* Merging the neighbourhood and geolocation data sets,
* Identifying suitable neighborhoods and selecting the relevant data,
* Creating and sorting new attributes that would enable the modelling,
* Segmenting the data as well as
* Removing or replacing blank or missing values.

## Modelling

*‘We need new, dynamic models for growth through the sharing economy, using big data to unlock new insights and adopting closed-loop cycles.’*

*Paul Polman (1956 - )* (Brainy Quote, 2019)

‘K means[[3]](#footnote-3)’ was used to model the geolocation data to inform the results; this was preceded by ‘One hot encoding[[4]](#footnote-4)’ which transforms the data to ensure that it is in a format that will enable modelling. ‘K means’ groups similar data points together and discover underlying patterns. The ‘K’ in ‘K Means’ is the number of groups or ‘clusters’ that the data points are grouped into and is specified by the user (or the Customer). (Towards Data Sceince, 2019)

# Results

## Toronto

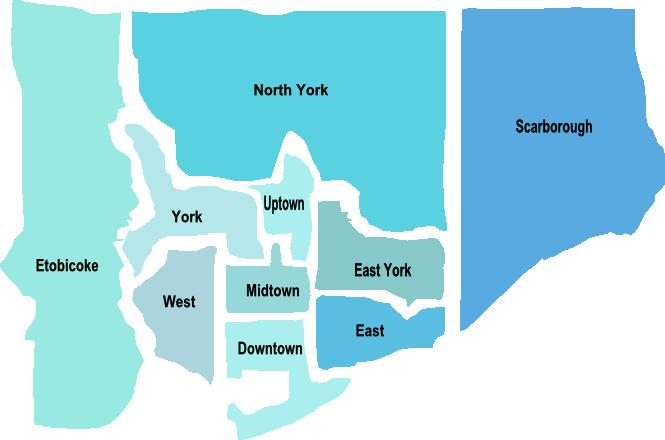


Figure - Toronto Neighbourhoods Map

As a quick reminder, some basic statistics about Toronto. Toronto is the provincial [capital](https://en.wikipedia.org/wiki/Capital_city) of Ontario, the [most populous city in Canada](https://en.wikipedia.org/wiki/List_of_the_100_largest_municipalities_in_Canada_by_population). Toronto covers an area of 630 square kilometers (243sqmi), [https://en.wikipedia.org/wiki/Toronto - cite\_note-population-72](https://en.wikipedia.org/wiki/Toronto#cite_note-population-72)with a maximum north–south distance of 21 kilometers (13mi) and a maximum east–west distance of 43 km (27mi). It has a 46-kilometre (29mi) long [waterfront](https://en.wikipedia.org/wiki/Toronto_waterfront) shoreline, on the northwestern shore of Lake Ontario.

## Downtown, Midtown and Uptown

The areas of concern were separated into 15 clusters of related Neighbourhoods. Table 1 shows the top 10 common venues by Neighbourhood. At the time of this analysis there were 836 venues in the Neighbourhoods.

Table - Common Venues by Neighbourhood – Downtown, Midtown and Uptown



## Etobicoke

Etobicoke was separated into 10 clusters of related Neighbourhoods, of comparable size to the Downtown, Midtown and Uptown Neighbourhoods. Table 2 shows the top 10 common venues by Neighbourhood. At the time of this analysis there were 72 venues in Etobicoke.

Table - Common Venues by Neighbourhood – Etobicoke



## Queens Park

Queens Park is within the Downtown, Midtown, Uptown Neighbourhood areas, but hazardous material free. Queens Park was included to see if it would be suitable for some organisations to relocate to. Queens Park was of a comparable size to a borough in the Downtown, Midtown and Uptown Neighbourhoods, and was left as a single cluster. Table 3 shows the top 10 common venues in Queens Park. At the time of this analysis there were 30 venues in Queens Park.

Table - Common Venues in Queens Park



## Cost Data

## Moving Costs

Green (Green, 2019) notes that the cost drivers for removals are:

* Time taken for the ‘uplift’ (ie to move out),
* Time taken for the ‘downlift’ (ie to move in),
* Time taken to travel between sites, and
* Number of people involved in the removal.

Extrapolating from Green’s data on apartment moves based on size and complexity of the venue the average[[5]](#footnote-5) figures per venue are contained in Table 4

Table – Average Removal Costs

|  | Time Taken (hrs) | Number of People | Incidentals | Cost ($(C) per hour)[[6]](#footnote-6),[[7]](#footnote-7) | Total ($) |
| --- | --- | --- | --- | --- | --- |
| Uplift | 10[[8]](#footnote-8) | 4 |  | 1,500.00 | 15,000.00 |
| Downlift | 7[[9]](#footnote-9) | 6 |  | 1,500.00 | 10,500.00 |
| Travel | 1 | 6 | Fuel surcharge - $40 |  | 40.00 |
|  |  |  | Travel Time - $1500.00 |  | 1500.00 |

Per venue the total moving costs on average would be $(C) 27,040.00.

## Hazardous Material Remediation Costs

Canada’s Restoration Services (Canada's Restoration Services, 2019) note that the cost drivers for Asbestos Removal are:

* Where the asbestos is found
* What type it is, and
* The severity

Extrapolating from the cost data provided on the website (Canada's Restoration Services, 2019) on abatement costs the cost per venue has been assumed to be $(C) 2000.00 per venue.

The time taken for each remediation depends on those same factors and can take up to 3 months. For the purpose of this cost exercise it has been assumed that each venue will take 1.5 months and that 3 venues can be remediated together. This means that the shortest time that all the 836 venues could be remediated in, is 16 years.

## Settlement Costs in Asbestos Liability Cases

In Australia (Colin Biggers & Paisley lawyers, 2019) noted that the highest compensation award for a six hour exposure to Asbestos was upwards of $((AUD) 300,000, or $(C) 275 K .

## Other Compensation arrangements

The Mesothelioma Guide (Mesothelioma Guide, 2019) notes that Veterans with mesothelioma qualify for a 100% disability rating which equates to a monthly figure of at least $(C)3057.00.

## Population Data

In 2019, the population of Toronto was 6.139M people. It is estimated that there are 235,700 veterans in Ontario, which is approximately 1.6% of Ontario’s population. With a population of 2.93 million people, Toronto is likely to be home to 99 thousand veterans.

# Discussion - Two Neighbourhoods and a Borough

*‘The asbestos problem impacts everyone’*

*John Engler(1948 - )* (Brainy Quotes, 2019)

Some of the buildings in several neighbourhoods (namely those near Downtown Toronto) may have been built using asbestos[[10]](#footnote-10); what is not known without further investigation is exactly how many business are affected.

## Venue profiles

The analysis identified that there were 836 venues that could be directly affected. These venues when normalized were distributed as shown in Figure 3.



Figure – Distribute of different venue types in the affected areas

A similar investigation into Etobicoke delivered the profile at Figure 4 for the same venue types.



Figure – Distribute of different venue types in Etobicoke

Initial investigations show that the Etobicoke did not have gaps in its venue profile that directly corresponded to the venue profile of the affected areas. The combined profile is shown in Figure 5. This profile shows that no more than 50% of the relocated venues would find active competition in Etobicoke.



Figure – Distribute of different venue types in both Neighbourhoods

As part of the research it was noticed that the borough of Queens Park comprised buildings of an age that it would be highly unlikely for them to contain asbestos. A similar analysis was undertaken, and the consequential profile of Queens Park is shown in Figure 6.



Figure – Distribute of different venue types in Queens Park

The profile of the three combined areas is shown in Figure 7. This profile shows that no more than 60% of the relocated venues would find competition in the two other locations.



Figure – Distribute of different venue types in the combined areas

## Relocation Cost Profiles

## Relocating all the venues in the affected area

As previously noted, 836 venues have been identified in the affected area. It would cost on average $(C) 27040.00 per venue for each relocation. Given that each venue would need be relocated and then relocated back to its original location post remediation work, the total cost of the relocation activity is likely to be $(C)45.2M

The cost of remediating each venue on average was assumed to be $(C)2K, increasing the total for all the venues of the relocation/remediation activities to almost $47M.

## Relocating those venues with no competition

Previously it has been noted that no more than 60% of the venues in the affected areas would find some form of competition in the relocation areas. The cost of just relocating the venues that had no competition would be a maximum of $(C)18.75M.

## Cost of compensation and other liabilities

## Compensation for the whole affected area

## One-off costs

As previously noted currently there are 6.139M people in Toronto in 103 Neighbourhoods. For cost estimation purposes, a linear distribution of the number of individuals across each of the 17 Neighbourhoods has been assumed; this means there are 1.01M individuals in the affected area. If each is entitled to the minimum compensation, then the total cost of that compensation would be nearly $(C)28,775M

## Ongoing costs

As previously noted, there are likely to be 47K veterans in Toronto in 103 Neighbourhoods. For cost estimation purposes, a linear distribution of the number of veterans across each of the 17 Neighbourhoods has been assumed; this means there are 7.76K veterans in the affected area. If each veteran is entitled to $3Kper month, then the annual bill for these ongoing costs to veterans is $(C) 233M.

The nature of asbestos is that it affects everyone and therefore even if 40% of the venues were to be relocated, everyone still could be entitled to compensation.

## Cost and liability profiles

## Relocating all the venues

Table 5 shows the cost profile for relocating the venues over a 16-year period.



Table – Cost profile for relocating all the venues

Table 6 shows the liability profile over a 16-year period should the relocation not go ahead.



Table – Liability profile for not relocating all the venues

## Relocating 40% of the venues

Table 7 shows the cost profile for relocating 40% the venues over a 14-year period.



Table – Cost profile for locating those venues that have no competition in the chosen areas

## Total Cost and liability comparison for both option

Table 8 shows the total cost and liability for both options, from this table it has been concluded that, on a cost basis alone, relocating and remediating all the venues over a 16 year period is the most effective solution for Toronto.

|  |  |
| --- | --- |
|  | Total |
| Relocation of all venues | $45,568,000.00 |
| Partial relocation | $17,920,000.00 |
| Liability | $29,900,920,000.00 |

Table – Total cost and liabilities for both options

# Conclusions

311 provides residents, businesses and visitors with easy access to non-emergency City services, programs and information 24 hours a day, seven days a week. 311 can offer assistance in more than 180 languages. (City of Toronto, 2019).

The City of Toronto has been made aware that some of the buildings in a number of areas (namely those near Downtown Toronto) may have been built using asbestos[[11]](#footnote-11).

Businesses that need to be relocated will be given access to the data to help them relocate into an area that provides them with good business opportunities. 311 commissioned this report to provide direction and guidance to the Senior Leadership Group on the financial implications of the discovery of the hazardous materials. Stakeholders directed that Etobicoke be considered as the primary location neighbourhood. Subsequent analysis identified that Queens Park contained venues that were unlikely to be contaminated due to their average age and could possibly be used to relocate a subset of the venues.

Analysing the number of venues, the relocation and remediation costs for each as well as undertaking a liability assessment for not undertaking any relocation or remediation work this report has shown that the most cost-effective solution is to relocate everybody to either Etobicoke or Queens Park. This could cost $(C) 45,568,000 that has not been budgeted for. Large as this figure is, it represent less than 1% of the potential liability cost of not relocating the venues.

Only relocating the subset of venues that have no competition in these areas would reduce the relocation costs alone. The remediation and liability costs would remain the same as remediation needs to take place on affected buildings and the nature of asbestos is that it affects everyone; therefore even if 40% of the venues were to be relocated, everyone could be entitled to compensation.

# Assumptions

The following assumptions were made during this work, that:

* Extrapolating from the cost data provided on the website on abatement costs the cost per venue is $(C) 2000.00.
* Each venue will take 1.5 months to remediate and that 3 venues can be remediated together.
* For cost estimation purposes, a linear distribution of the population of each of the 17 Neighbourhoods has been used.
* For cost estimation purposes, a linear distribution of the population of veterans in each of the 17 Neighbourhoods has been used.
* Average is taken as the arithmetic mean.

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1. Please note this is a fictious construct for the purposes of the Capstone Project. [↑](#footnote-ref-1)
2. Please note this is a fictious construct for the purposes of the report. [↑](#footnote-ref-2)
3. <https://towardsdatascience.com/understanding-k-means-clustering-in-machine-learning-6a6e67336aa1> [↑](#footnote-ref-3)
4. <https://hackernoon.com/what-is-one-hot-encoding-why-and-when-do-you-have-to-use-it-e3c6186d008f> [↑](#footnote-ref-4)
5. Average is taken as the arithmetic mean. [↑](#footnote-ref-5)
6. Excluding taxes [↑](#footnote-ref-6)
7. Costs at 2019 rates [↑](#footnote-ref-7)
8. Includes packing [↑](#footnote-ref-8)
9. Excludes unpacking [↑](#footnote-ref-9)
10. Please note this is a fictious construct for the purposes of the report. [↑](#footnote-ref-10)
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