CASE STUDY

A large city shines internationally with its innovations in asset management

PROJECT SUMMARY

The City of Montreal wanted to evaluate its infrastructure maintenance deficit in relation to its target service levels. The data obtained would be used to inform a strategic investment plan aimed at addressing the maintenance deficit over the medium term while reducing costs. The objective was to select the most cost-effective options for reaching its objectives in the short, medium and long terms.

- 4,000 km of water mains
- 4,800 km of sewer mains
- 4,000 km of roads
- 1,650,000 inhabitants
- Value of assets: ≈ $50B

"The results of our analyses show that a targeted proactive approach to interventions is very profitable, leading to savings of 30 to 50% while maintaining an equivalent or better level of service"

(Source: ceriu.qc.ca, page 28)

BACKGROUND

- The City of Montreal was spending hundreds of millions of dollars annually on maintaining and renewing its water supply (water mains), wastewater (sewer) and roadway (pavement and sidewalks) infrastructure.
- Several decades of chronic underinvestment had resulted in a significant maintenance deficit.
- Given the advanced age of most of the City's underground water pipes, it was estimated that the majority of the network would need to be renewed in the short or medium term.
- The City was also faced with the increasing deterioration of its roads due to the annual freeze-thaw cycle, combined with advanced subsoil deterioration, leading to a sharp increase in the number of potholes.
- Complete reconstruction was the asset renewal strategy advocated by most of the City's experts; rehabilitation strategies to extend the life of assets were not often considered.

RESULTS

- Reduction of total asset lifecycle costs and annual investment needs while targeting the same service levels.
- Quick and easy quantification of the short-, medium- and long-term consequences of budgetary adjustments. Development of a medium- and long-term strategic vision to better manage workforce requirements.
- Measurement of the cost of life extension interventions (rehabilitation) on the overall lifecycle of assets.
- Optimization of decision-making processes for asset maintenance and sustainability through the selection of the most cost-effective intervention synchronization strategies.
- Extraction of the list of works to be carried out according to all applicable constraints.
- Justification of implemented strategies to elected officials.
- Consolidation of expertise and centralization of the knowledge base within a single platform.

CHALLENGES

- Creating a model of all network assets and aggregating them in the form of segments so that various synchronization rules can be applied.
- Factoring in the physical constraints generated by the co-existence of assets (e.g. need to open the roadway and replace water mains when replacing sewers, etc.)
- Developing an asset-centric model showing the evolution of its condition according to evolutive attributes (age, condition and material, etc.) and non-evolutive attributes (location, size, hierarchy, etc.).
- Demonstrating the effectiveness achieved through the selection of various lifespan extension options in order to update existing decision-making processes and obtain a better return on investment.
- Prioritizing renewal work while preserving a balance between reducing the number of assets in poor condition and reducing costs, all while avoiding any loss of intervention options.
- Analyzing the maintenance deficit in relation to desired levels of service, and quantifying the resources and timelines required to reduce and manage this deficit.
- Drawing up a long-term investment plan, including projected levels of service.
- Generating a list of works (intervention plan) for planners to implement long-term strategies.

KEY REQUIREMENTS

- Replacing Excel, which is no longer the most suitable option due to the high number of assets and the need to consider their full lifecycle when assessing the cost-effectiveness of proposed long-term strategies.
- Moving away from tools with a deterministic approach, because options for work synchronization can vary according to the uncertainties inherent to individual assets.
- Creating an accurate financial model able to demonstrate the cost-effectiveness of lifespan extension strategies (rehabilitation of water mains and sewers) in order to minimize invasive and unnecessary interventions.
- Eliminating the use of standard advanced modeling tools (Matlab, Python), which prevent a reliable operationalization of strategies and can compromise the long-term sustainability of the model (lack of documentation, difficulty in changing rules, departure of persons responsible for programming, etc.).

OUR SOLUTION

- The network was broken down into asset classes that were modeled individually using drag-and-drop functionalities, without any line of code, ensuring the sustainability and longevity of the solution.
- The internal expertise of infrastructure managers was digitized, including the modeling of assets evolution and decision-making processes (decision trees) overtime.
- The criticality level of each network component was modeled according to various factors such as age, materials, dimensions, failure history, etc.
- A model was developed to prioritize interventions on the most critical segments while managing risks related to loss of rehabilitation options and reducing the number of assets in poor condition.
- A set of constraints has been configured in order to take account of the various budget allocations and capacities to carry out the work from the various jurisdictions participating in project management and realization (districts, suburban municipalities, agglomerations).
- All interdependencies between network components were incorporated into the model, making it possible to implement optimal work synchronization strategies and consider the effects of individual interventions on co-existing assets within the same segment.