RAPIBUS

CANADIAN CONSULTING ENGINEERING AWARDS 2016

Les Promenades station in the Rapibus corridor

PROJECT INTRODUCTION: CREATING CRITICAL CONNECTIONS

Rapibus is a Bus Rapid Transit (BRT) public transportation project consisting mainly of the insertion of a two-way corridor, approximately 12 kilometres long, as a reserved bus lane extending directly over an existing operational—yet underused—railway reserved for buses. With ten stations, all designed with the vision of providing a high-frequency link between local neighborhoods and the Ottawa and Hull city centres, Rapibus is integral to a vast majority of commuters on their journeys to and fro work. The corridor runs from east to west through the City of Gatineau, ending in Ottawa where a new network of reserved lanes.

The Rapibus project also includes the addition of a full bike lane, which aims to solve the problem of existing gaps in the network between the east and west parts of the city. Thanks to the addition of a bike bridge alongside the Black Bridge (Pont Noir) crossing the Gatineau River, the lack of a direct, fast connection between the Gatineau and Hull areas could be resolved, thereby promoting the use of bikes as a efficient means of commuting to work.

Rapibus is a transportation project encompassing elements of urban development and municipal infrastructure. Rapibus has fundamentally transformed the existing urban fabric. After just two years in operation, the BRT is already influencing the increasing population of the city outskirts: new residential and commercial projects are in development and it is clear that each station has become a recognizable part of the urban landscape. While the stations have a functional purpose, they also serve as a nod to history; themed signs symbolizing the history of each area decorate the stations.

Overall, the Rapibus project transformed an industrial railway corridor into an integrated urban corridor that brings added value to its environment and community. The functionality of its transportation infrastructures, in addition to its carefully planned landscape development, is the defining feature of this project.

The quality of the design and the attention to detail from the consortium played a key role in reaching the client's goal. It should be noted that there is no guide or standard for inserting a road corridor directly over a railway. The flexibility, ingenuity and expertise of all the designers on the consortium team contributed to the success of Rapibus, and resulted in a one-of-a-kind project.

WHY RAPIBUS?

The City of Gatineau has seen sustained growth since the early 2000s and is, today, the fourth largest city in the province of Quebec. Its proximity to the country's capital attracts a large number of people and investors. It also presents an alluring prospect for future development. For these reasons, it became necessary to enhance the city's public transportation network, which at the time was mostly consisted of local bus networks and express routes that had reached maximum capacity. After several evaluations and studies conducted by the Société de transport de l'Outaouais (STO), the chosen system was a BRT solution. It was the best and most suited for the population's mobility needs while maximizing the economic profitability of operating the system. In all, the goal of the Rapibus project was to improve the user experience by combining the reliability of a reserved corridor with the flexibility of bus transportation.

THE ROLE OF THE CONSULTANT ENGINEER

FIRM SELECTION METHOD

In the course of carrying out the Rapibus project, several bidding processes were conducted. The main one was for a hot topic regarding this new BRT: the road corridor that would serve as a link between the stations, the existing urban network and the city's main travel hubs.

The corridor project aimed to meticulously plan and carry out concepts developed through feasibility studies. This included creating detailed plans and quotes, estimates, bidding documents and on-site monitoring of the entire corridor separated into different construction packages. The project was awarded to the GDR consortium, which was composed of the firms WSP Canada Inc., Stantec Inc., and Norda Stelo Inc.

The selection method was standard, using a public bidding process, and included a "job showing" site visit. The evaluation criteria included a "quality" component and a "price" component. For the "quality" component, the bidder had to demonstrate their ability to carry out a major multidisciplinary project while adhering to a competitive timeline. Required expertise included, in particular, municipal engineering (sewers, water mains, pumping stations, etc.), road engineering, traffic light expertise, bridges and works of art, lighting and rail engineering. The firm also had to demonstrate its ability to design a project to integrate into the existing urban fabric. Because of its location at the heart of the city, the success of the Rapibus project was, in fact, closely tied to its successful integration into the space.

As for the client, they were supported by a management firm to effectively carry out this traditional bidding process.

ADDED VALUE

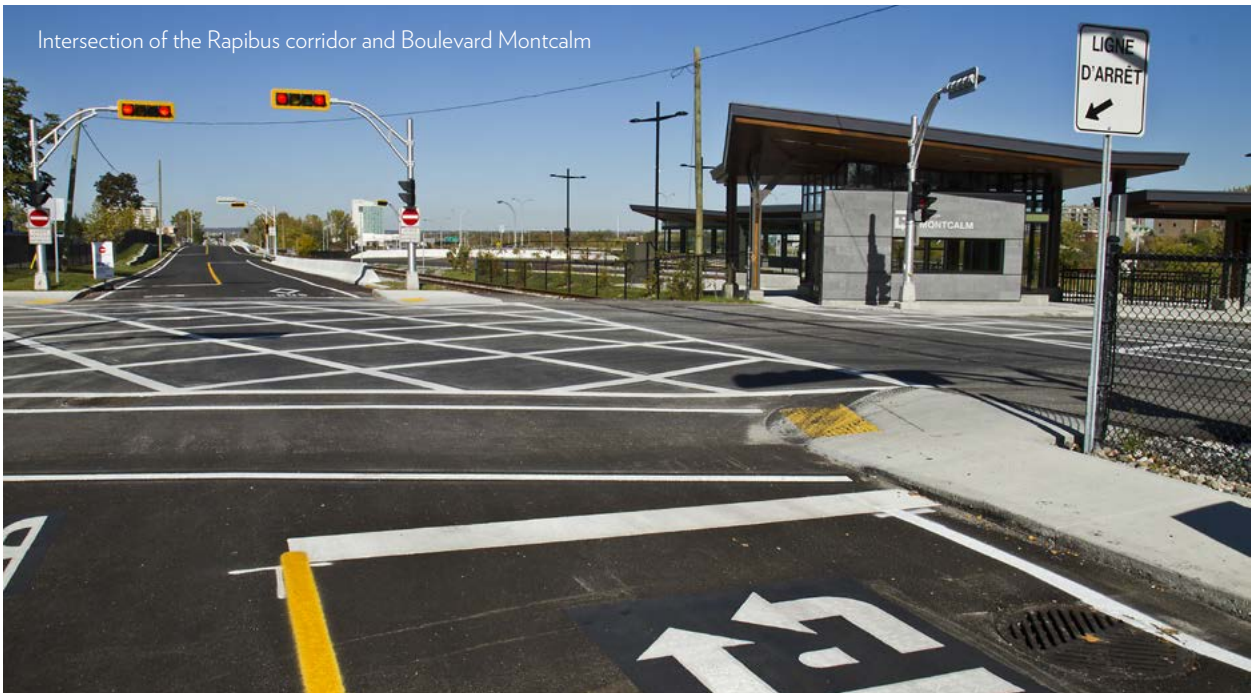
The GDR consortium's contribution was crucial to the project's success. This team of highly qualified professionals was able to translate the concepts into tangible and feasible elements. In the pursuit of their goal, preliminary and definitive pre-project study steps were added to the project on the recommendation of the consortium. Due to its linear nature, the project was challenged by several hurdles. This step therefore allowed for revisions and necessary adjustments to be made to refine the project. Ultimately, it provided clear support and approval from all parties involved and authorities that had jurisdiction over the major design decisions and directions. These approvals then guided all the subsequent steps of carrying out the project.

As mentioned supra, there has never been a standard or official guide for adding a public transportation corridor on a railway. Impeccable engineering coordination for all parts of the project was therefore essential. Among other results, this context prompted the creation of new design parameters (pavement type for buses, coexistence of trains/drivers/cyclists/pedestrians), innovative methods to comply with railway signage standards—which were subsequently approved by the Quebec Ministry of Transportation (MTQ)—and the creation of new signage.

The expertise of the technical team was harnessed to overcome the project's challenges and to secure the budget, determine the land to purchase and obtain numerous required authorizations [rail MTQ, Transport Québec, rail operator, City of Gatineau, NCC, Fisheries and Oceans, Environment Canada, Quebec Ministry of Sustainable Development, Environment and Parks (MDDELCC), Transport Canada, etc.]. A rail security analysis was required and was conducted successfully. A road safety audit was also conducted successfully by the MTQ.

The completion of the Rapibus project would not have been possible without constant meticulous coordination of the various foci and strict progress monitoring, which extended over five years. To do so, the consortium established a permanent project office. This office included the implementation of a complete management team to ensure the consortium's internal functions as well as relations with the client, their manager and all external partners. The goal of the project office was to manage all the information and communication related to the project. At the beginning of the project, a single point of contact was established by nominating a "designer manager" to centralize and collect information, ensure monitoring and archive all the consortium's data. The role of the designer manager included technical coordination between the various internal and external elements of the project team. With help from this resource, the consortium maintained excellent quality control and consistency in document presentation, selecting design criteria and ensuring coordination between different foci.

The project office was responsible for guiding the client in all its tasks, advising them on different technical challenges during the hiring process and conducting technical and administrative coordination of the client's external consultants and partners.



Intersection of the Rapibus corridor and Boulevard Montcalm

New signage

The project office created a quality plan and a design revision process by establishing a structured and progressive information request process to correctly document each decision. This process also facilitated monitoring of each aspect of the project, as well as environmental authorization requests to the MTQ rail division, the City of Gatineau, etc.

This ability to overcome technical and organizational challenges shows the consortium team's wide range of skills and the added value it brought to the project.

MANAGING HUMAN CAPITAL

One of the biggest challenges of the project was to create a state-of-the-art team to work under collective responsibility. The combination of three firms, the large number of foci involved and the geographic distribution of experts in different cities added to the challenge.

RESOURCES SELECTION AND TEAM MAKEUP

Before creating the project team, a generic organization chart was developed to establish the organizational structure of different foci under the direction of the project office management team. Next, a review of the best candidates was conducted to select the section leaders and the operational teams. The fact that the consortium had members from three firms at its disposal ensured optimal selection of resources and experts from the best of the best.

The creation of the project office and the continuous dedicated presence of the designer manager contributed to this team's cohesion and engagement. This type of project office ensures clear identification a reference resource to establish and monitor uniform processes for such a large and varied team.

In order to ensure that everyone felt a sense of belonging to the team, it was crucial that the members were aware of each person's role and knew each other. Information management and human capital management are key to success for projects of such scope. A project binder was compiled, containing the detailed organizational chart for the consortium as well as team contact information. An FTP site was also created so that all consortium members and foci could access the project data, including the delivery schedules. Staff could therefore quickly find their bearings for the project and the team. The project was divided based on the construction packages and the foci involved in them. Clear, precise responsibilities were assigned to each person to promote clear understanding of their role and each person's decision-making power.

Both in-person meetings and teleconferences were organized on a regular basis. These meetings—depending on the circumstances—sometimes brought together section leaders, sometimes production teams, sometimes administrative teams, but always included the project office. At the larger, all-team meetings, various team members could meet everyone involved in the project. This method ensured cohesion, created a feeling of teamwork, and promoted engagement.

TEAM MOBILIZATION AND MOTIVATION

As mentioned in the previous section, group meetings were scheduled throughout the project to ensure team mobilization. Global team meetings and organized site visits took place as well. This allowed team members to see the project during and after production. It should be noted that per our request, the client allowed a guided visit (and even made a bus available for the project team) just before the Rapibus opened to the public. Enthusiasm and pride were evident by the number of team members who eagerly took part in the aforementioned tour.

Branding also contributed to the sense of unity and helped prompt team mobilization. The consortium was identified by its logo and personalized signature on all documents prepared by the consortium (letters, e-mails, plans, quotes, monitoring logs, site memos, etc.). Site helmets and vests were no exception; they all proudly displayed the consortium logo. The section leaders and the project office served as mentors for the design team. Kickoff and design meetings were routinely scheduled for each of the packages. This allowed the team to discuss specific challenges and recommend customized solutions. Also, inter-section revisions, created by members other than the designers, were planned for meticulous coordination and quality control purposes.

OCCUPATIONAL HEALTH AND SAFETY

The project binder included the contact information of all resource and key personnel. If the need arose, any employee could be quickly identified or contacted. The existence of a single point of contact for the client, the designer manager also facilitated communication and access to the consortium team in the event of an incident or other similar issues.

The quality plan created by the consortium included a section on Occupational Health and Safety (OHS) and involved regular meetings with employees. It also included discussion points for site meetings with various contractors. A specific communication plan was devised depending on the types of situations and scenarios; this helped increase OHS awareness among the various team members Helmets and vests with the consortium logo allowed for quick validation that the protective gear and equipment were used and worn properly.

In conclusion, each site visit was organized in advance, whether it was with the rail operator or the construction manager. As such, both the consortium employees and the site manager were up-to-date about the team's presence on the site. This also provided a way for specific directions to be given to employees as required. The sites accumulated 700,000 hours worked without any major accidents occurring.

ADDITIONAL PROJECT DETAILS

COMPLEXITY

The Rapibus project is characterized by its nature as a prototype developed from various parts. It also stands out for its integration into a mature urban fabric. These elements give it a high level of complexity. As mentioned previously, there does not exist a guide or standard related to adding a bus corridor to a railway while keeping both modes of transportation operational, not to mention adding a bike lane as well.

This element of coexistence presented a variety of challenges mostly to mitigate conflicts between the different modes of active and non-active transportation and all potential safety-related issues:

- Regulatory separation distance to maintain (railway pattern) in a cramped space within an area that is already densely developed
- Conflict between bus entrances and exits and railway regulations (signage equipment, visibility distance, prohibited for the rail to cross near an intersection, required angle of approach, etc.)
- Cyclists' safety near stations and connections to existing lanes in the municipal network
- Safety of pedestrians and drivers present at each of the intersections crossed by the Rapibus corridor

In order to make all three modes of transportation exist harmoniously, the ingenuity and expertise of experts in areas as varied as works of art, rail engineering, traffic management, electrical engineering, municipal engineering, road engineering and lighting were essential. The project required managing a largely multidisciplinary team, which was also a unique challenge.

cohabitation train-automobiliste-cycliste et piéton

The work of all these teams inevitably required a large number of authorization requests pertaining to different authorities, both within and outside of the Environment sector. To name a few, there were: authorizations required from the railway division of the MTQ, the overall MTQ, the MDDELCC, Fisheries and Oceans Canada, Environment Canada, the National Capital Commission (NCC), Chemins de fer Québec-Gatineau (the rail operator), Transport Canada, the Compagnie de chemin de fer de l'Outaouais (CCFO) and the City of Gatineau. As one can imagine, projects with no specific reference guide often experience and plan to overcome extraordinary complexities that standard projects would not. As a matter of fact, each design element required a range of existing regulations that are not intrinsically applicable to all the design situations encountered with the Rapibus project.

Furthermore, to make matters more interesting, the project was also conducted in "fast track" mode. This production mode added another level of difficulty to a project that was already quite complex. This resulted in multiple construction packages operating in parallel, for which construction extended over four years. It was necessary to make interactions between the different packages possible. It was clear that the level of detail in each plan and for each design element were in a safe place to avoid conflict between the packages thanks to the dedication, expertise and management of the consortium.

ONE SIZE DOES NOT FIT ALL: UNIQUE SOLUTIONS FOR A UNIQUE PROJECT

The constant search for safe, functional solutions was necessary in order to comply with requirements of the aforementioned agencies and organizations. This resulted in creating new signage, obtaining authorizations requested by the consortium and/or recommended by the MTQ and selecting materials. Overall, unique solutions were developed to respond to each challenge.

Besides the enlargement of two existing railway overpasses and the construction of three bike tunnels, a unique example of a technical solution (work of art, road engineering, lighting, traffic lights and rail engineering) is the level of coexistence on the Black Bridge. To travel from the Gatineau area to the Hull area, the Rapibus must inevitably cross over the Gatineau River. It was decided to use the existing infrastructure, the Black Bridge, to accomplish this. This railway bridge with the width of a single railway track dates back to 1877. It is important to note that constructing a new bridge was not possible with the budget. Trains traveling in both directions—in addition to buses also traveling in both directions—needed to coexist on this single track. This passage is approximately 250 metres long.

Approaching the Black Bridge

The consortium worked closely with the client and their partners for the chosen solution to work with STO network operations (routes and rush hours), traffic management (train, lights and signage) and user prioritization (cooperative protocol with the two railway operators). The originality of the solutions also was due to the materials selection and arrangement so that everything would be functional and safe. Developing solutions involving combinations of steel, wood ties, ballast, asphalt and an open grating rail surface required an enormous amount of ingenuity from designers while still respecting the abilities and constraints of the existing bolted steel structure of the bridge. The bike lane bridge, joined to this bridge, also added a layer of complexity to the challenge. Carrying static loads needed to be very limited on this bridge. It also had to allow for avoiding problems of balancing loads, because the lane could only exist as an overhang considering the narrowness of the original bridge.

Interactions between various modes of transportation also had an impact in other locations, especially at intersections with municipal road networks. The design had to take into account not only the existence of railways, but also the Rapibus corridor lanes. As such, each system of traffic lights was studied separately and in conjunction, in order to ensure that the fluidity of the Rapibus would not have a negative impact on the municipal network. Specific signage and marking was also developed so that users can cross the corridor safely while avoiding entering or blocking it. The consortium also participated in the development of informational campaigns to raise user awareness of the new configuration of intersections and the existence of new signage and marking.

The entrances and exits for buses are designed to ensure fluidity and safety on municipal networks without infringing on railway standards. Requests for new reserved passages were also prepared by the consortium and approved by the rail division of the MTQ. The photo below shows one example of an entrance/exit between the road network, a Rapibus station and the corridor.

It is important to note that the railway corridor already had its own infrastructures; it drained at specific points in the municipal networks and a regional fiber optic line existed there and that numerous municipal infrastructures were located at the intersections. The Rapibus also had its own requirements for communication and drainage lines. The addition of the Rapibus would increase the density of various lines in an area that was already quite full. The land was not suitable for multipurpose usage (bus, bike lane, etc.) because the railway was originally intended to serve as a railroad. The consortium was innovative and demonstrated flexibility in order to make all of these infrastructures coexist functionally while optimizing the existing municipal networks.

As an example, line and surface retention was added in order to avoid overloading the municipal networks. A secured technical line from Bell and another from Hydro-Québec serving 30,000 subscribers as well as the water mains and sewer networks were completely redesigned and/or relocated at the Boulevard Gréber intersection. These relocations were required for construction of the first tunnel in the region, which required excavation measuring over 60 metres long and 10 metres deep right in the city center. This tunnel was essential in order to ensure a quick passage for the Rapibus at this high-traffic intersection. A pre-made pumping station with a counterweight system was selected for draining water runoff. The available constrained space and the challenges in potential heaving at the bottom (related to groundwater recharge) made design of this structure very complicated.

Montcalm station – Integration in the area and fusion with the Boulevard des Allumettières

Entrance and exit for the Rapibus corridor

The design also took into account the reuse of existing soil, including contaminated soil:. the profiles, embankment selection, and the addition of a berm were optimized to support this reuse.

Overall, the consortium demonstrated originality and expertise in order to design all the parts of a truly unique project. Several decision-makers and transportation network managers, including international visitors, came to see the project for inspiration in carrying out their own projects. The Rapibus project was now a reference for others.


Gréber tunnel


Les Promenades station approaching the Gréber tunnel

FUNCTIONALITY

As mentioned supra, the project aimed to create a dedicated corridor for Rapibus buses on a railway that had to remain functional, all while adding a bike lane. The entire project had to consider other users such as pedestrians, drivers and various municipal networks and public utilities. The Rapibus had to leave a positive footprint in the community, both in its functionality and integration. Its presence had to represent added value for its immediate environment, including municipal roads, sewers, water mains and future development.

All of these goals were achieved: the corridor was completed and functionally is embraced by the communities. The same can be said for the Gatineau-Hull bike route. The bike lane operates without disturbing municipal traffic. Corridor management ensures that the sewer networks are in fact relieved by the existence of the Rapibus (retention) and that the lines under the corridor were replaced when they were worn out and designed based on future developments in the City of Gatineau.

No part of the City of Gatineau was isolated by the Rapibus whether in terms of road development or infrastructures. The materials and amount of decoration were determined carefully to ensure smooth integration of the project into the urban fabric.

The Rapibus was fully functional by the time of its official inauguration. The popularity of this new transportation has continued to grow since its inception. An increase in the customer base can be noticed and, as further proof of the project's success, future enhancement phases are currently being studied. In fact, users from the currently non-serviced areas are requesting Rapibus connections, both on the far-east side of Gatineau and on the west side towards the Aylmer area. The extension of Rapibus was one of the top topics in the region's last municipal election.

BUDGET

The project was reasonably restructured during the design studies. Following various additional studies, including the definitive pre-project study, a final budget was established. This phase ensured the project was consolidated on a solid, clear foundation while ensuring a full understanding of the underlying challenges. The revised budget, which received an additional $40 million grant from the MTQ, was adhered to.

To make sure all this took place, several concepts were studied and followed by optimization meetings; the client participated in these meetings. A pre-existing material reuse strategy was also highlighted during the meetings which prompted the reuse of contaminated soils, railroad ties, rails, and railway hardware.

These design criteria were also subject to review for cost-controlling purposes. "Durability vs. cost" checks were performed based on the criteria used for selecting the types and thicknesses of asphalt.

The consortium actively participated in value analysis workshops to validate all the selections and their related costs.

TIMELINE

Following various additional studies and the submission of the definitive pre-project study, an opening date was set by the client. This date was communicated to the general public in the interest of transparency, a priority for the client. To avoid losing the public's trust in a project that was already being widely discussed in the media, it was crucial to meet this deadline. The opening date was met with a unique and revolutionary project that was complete and fully functional.

To achieve the deadline, the client opted for a "fast track" mode including 15 construction packages extending over four years. The consortium played an important role in guiding the client anticipate technical challenges, plan numerous approval schedules and steps required to prepare for them. The consortium's management style with a permanent project office largely contributed to this success, as did the quality of the resources at its disposal.

SUSTAINABILITY AT THE CORE OF PROJECT DEVELOPMENT

The steady increase of motor vehicle use puts additional pressure on transportation infrastructures in Outaouais. The search for a viable solution had been an important topic since 1994 and had remained at the heart of local municipality debates. The Rapibus project is the fruit of these numerous studies, reflections and consultations that brought the regional key players together to enact on a long awaited alternative transportation solution. The Rapibus project is the largest construction site that the City of Gatineau has seen to date. It stands among the largest public transportation projects of the decade that were financed and executed in Quebec.

From the beginning, proactive communication plans were used in reaching out to the residents; notably, these methods largely contributed to the project's success. The consortium was present for 11 informational meetings, which were held in each neighborhood to provide technical explanations to the residents, gather feedback, and adjust the project accordingly to minimize the inconvenient effects of completing a project of such scope. To this effect, the consortium made sure to develop methods to control erosion, water runoff, dust and traffic management (cars, rail, pedestrians, cyclists). Proactive communication also encompassed working closely with the client's communications team.

The customized approach used to communicate with the residents was also reflected in the follow-up and modifications to the original action plan related to certain specific challenges and expectations of individuals. The consortium supplied the client's communications team with relevant technical data as part of regular update. The information and data were posted on the project-specific website and included in 22 newsletters whose audience included the project partners.

The Rapibus transformed an industrial rail corridor into an integrated urban corridor

The consortium also played a key role in defining design criteria and selecting materials to create a sustainable project. The corridor included a considerable amount of contaminated soils. The consortium ensured that the materials were repurposed as much as possible while safely removing materials that were no longer reusable. The project also included moving the railway line. The consortium ensured the existing railway materials (ties, rails, etc.) were reused as much as possible in order to minimize costs while also minimizing the environmental footprint of the project. The consortium made sure that corrections and replacements related to the municipal infrastructures encountered during the project were addressed on a timely manner. For example, the worn-out sewers and water main were replaced within the corridor limits and its surroundings. The consortium also re-opened and developed numerous solutions in view of ensuring that future development on all sides of the corridor would not be cut off or stopped by the development of this BRT network. Anticipating future needs of the communities were considered in deciding the size of lines and positioning of intersections.

Further elaborating on the topic of sustainability, the railway was comprised components which were drained by open channels that were overall well-organized and did not control the water runoff and sediment. The channels were also more or less maintained and included a large amount of miscellaneous waste. During the design phase, the consortium managed the organization of drainage, implementation of quality control for water and runoff (retention basin and sediment collection basin) and railway cleaning. The consortium was therefore able to ensure that the project's final footprint in water management was a positive one.

One of the many community engagement priorities implemented by the consortium included murals designed by six graffiti artists. There was also an art installation outside the De la Cité station which was coordinated by the consortium's civil engineering team. There was also a tree-planting program in areas identified by the consortium. The Rapibus infrastructures were designed for large-capacity buses, which are more environmentally friendly and provide increased passenger comfort. Many people have referred to the Rapibus as "the subway on asphalt." The Rapibus is an eloquent example of sustainable transportation that easily blends into the urban décor while embellishing and revitalizing its framework and landscape. It is a major community achievement that easily contributes to the vibrant energy of the city.

TRAILBLAZING IMPACT ON THE PROFESSION

Without an existing guide or design standard for a BRT designed to run on a railway corridor, the project was innovative in itself. This project was created de facto from innovative ideas. In this sense, the solutions applied in the project serve as a reference for the profession. The design of the coexisting railway and buses on the Black Bridge is revolutionary, not to mention the unique signage around the corridor and the specific phasing of traffic lights.

The consortium also developed a specific management style in regards to the project office and the appointment of the designer manager. This approach, now a more common method in Europe, was very innovative at the time of the start of the project in Canada in 2008. This approach has now been used in other projects conducted by the consortium members.

Before the official inauguration of the Rapibus, visits from dignitaries, mayors, members of Parliament, and senior government officials were organized by the STO. The consortium was present to explain the various dimensions of the project and to illustrate further details on some of the more groundbreaking technical solutions on which the project was built. Around the same time in October 2013, the BRT network was put under the spotlight as the featured project in the midst of the Association du transport urbain du Québec (ATUQ) conference. Several decision-makers and transportation network managers across the country and beyond came to learn more about the project so as to use it as a reference for their own projects.

Rapibus was also featured at the Canadian Urban Transit Association (CUTA) conference held in Gatineau in May 2014. Several consortium members attended the conference. Many were asked to lead guided tours organized by the conference organizers to provide technical explanations to the participants. Events as these have surely increased the influence of the project and the consulting engineering profession, too.

The project is an ideal example of innovative RBT systems. It serves as a local, provincial, national and even international inspiration and reference to the ever-changing public transportation sector. The consortium members, today, use the project as a reference when marketing their service offerings.


STATION
LES PROMENADES