IBM's Smarter Cities Challenge

Edmonton

Report

IBM

Contents

1. Executive summary

Cities, when dealing with their operational objectives and responsibilities, traditionally act within silos or semi-autonomously. However, all cities whether large or small are outgrowing current systems and processes. The approach of the city to its overall management and operations has changed, with a shift towards a "systems of systems" view. This is driving significant innovation.

By this "systems of systems" view we mean that valued attributes of high-functioning urban environments – culture, mobility, safety and so on – "emerge" from the interaction of a variety of private and public systems or networks. Just as police alone do not create public safety nor museums generate urban culture, no single system determines whether an urban environment is thriving or declining. These systems act in parallel, are interdependent and subject to non-linear dynamics. They rely largely on the individual decisions of a wide variety of people and organizations within them.

Cities are not managed in a top-down fashion. One should consider the role of local government as that of creating the conditions within which such systems can effectively function. While the citizen may expect too much of their ability to influence desired urban outcomes, local governments can nevertheless shape the conditions that make these possible.

A Smarter City is a city that can balance its social, commercial and environmental needs whilst optimizing the resources it has available. By applying advanced information technologies (IT), analytics and systems thinking to plan, design, build and operate its infrastructure, a city can improve its quality of life and economic well-being. These are the terms in which we define a smarter city.

Current transportation systems and associated infrastructures are strained. With a growing population and increased demands for mobility from a diverse community, these systems and networks will become even more burdened.

The key to smarter transportation lies in the ability to integrate various data sets from across static, real-time and dynamic data sources with the use of sensors, meters and software. This requires the application of a holistic framework in smarter data via analytics and is fundamental to a smarter transportation and road safety system. Smarter traffic integrates technology and intelligence in the transport infrastructure. Transportation authorities can thus improve capacity, enhance travelers' experiences and increase the efficiency, safety and security of the city's transportation system.

To change these systems, governments must not only transform the way they think about themselves and how they deliver services, but also the manner in which technology can enhance their engagement with citizens.

They must move away from a siloed approach to service delivery and move towards the principles of a Smarter Government. Innovative and integrated governments focus on the increased adoption of shared information, transparency, instrumentation, collaboration across agencies and intelligent use of analytics. Smarter Government allows them to personalize services in order to meet very specific individual (rather than group) needs.

Importantly, it uses new social networking technologies in highly creative ways to better predict the outcomes of decisions. Through continuous and immediate feedback loops, governments learn about and respond quickly to what is happening on the ground as their citizens receive their services. This in turn allows them to better tailor their offerings.

Smarter government supports innovative leadership by creating a networked environment which inspires and encourages its leaders to pro-actively share ideas and consider the broader ecosystem when designing policy and delivering services. The City of Edmonton Strategic Plan 2009-2018, "The Way Ahead" provides a focus on the City's efforts to supply those services and infrastructure that are of the greatest value to Edmontonians, while managing the opportunities and challenges of this ever-changing city.

The City's transportation vision, The Way we Move outlines the framework for an integrated and responsive transport system and sustainable land use. It encourages multi-modal transportation (freight, roads, rail, buses, sidewalks and light rail transit) to ensure the efficient and safe movement of its citizens.

Within the context of this strategic framework, Edmonton's mission is to be the global leader in urban traffic safety. It has adopted a longer term Vision Zero for fatalities and serious injury collisions, with shorter term strategies and targets using safe system approach. The City's Office of Traffic Safety (OTS) is renowned worldwide for its work and leadership. Its international conferences have sought greater collaboration among experts, enforcement agencies, governments and universities, to drive forward the mission of better traffic safety.

Although the City has ambitious goals in urban traffic safety and transportation, it is well placed to achieve them. With its strong culture of innovation and its progressive citizen-focused services, the City has made significant investments in state-of-the-art road safety instrumentation.

Furthermore, the culture of business intelligence and analytics is embedded across Edmonton's Transportation and Policing portfolios. Crime prediction and prevention within the Edmonton Police Service (EPS) uses business intelligence and intelligence-led crime and safety predictive analytics.

For the Smarter Cities Challenge, IBM was tasked with providing the City of Edmonton with ideas and recommendations to improve the integration, analysis and dissemination of data used for decision-making on traffic safety issues, and the prioritization of road safety initiatives.

As a result, IBM is pleased to provide the following recommendations in order to accelerate Edmonton's Vision Zero for urban traffic safety, and to support those The Way We Move strategies for an integrated and safer transportation network. To achieve the desired goals for citizens, community and business, we are proposing that the City:

1. Create an Analytics Centre of Excellence to support a Road Safety data governance model and analytics leadership across the organization;
2. Strengthen governance and accountability with respect to OTS;
3. Further support open government and open data for traffic safety and transportation;
4. Simplifiy performance measurements and align department traffic safety measures to corporate outcomes;
5. Empower citizens with timely traffic safety and transportation information via social media and embrace bi-directional citizen communication;
6. Aggressively position Edmonton as a global leader in smarter urban traffic safety, including initiating collaboration with global leaders in the industry and academia, in order to identify a unique traffic safety/ transportation research project.

By building upon these foundations, we believe the City will be able to fast-track its transformational roadmap for an integrated and smarter urban traffic safety framework and, in doing so, accelerate its standing as the global centre of excellence and expertise in urban traffic safety.

2. Introduction

2.1. The Smarter Cities Challenge

IBM's Smarter Cities Challenge is a new initiative that aims to contribute to the improvement of high-potential cities around the world. In June 2011, a team of six IBM executives worked in Edmonton with City leaders, the Office of Traffic Safety, the Edmonton Police Services and many other key stakeholders to deliver recommendations around a key challenge, as identified by the Mayor of Edmonton, Stephen Mandel, and his senior leadership team.

2.2. Project objective

IBM's mission for the project as determined by the City of Edmonton was two-fold:

a) Investigate the ways to which the city can make better use of existing data and shift toward a more integrated, predictive and intelligent transportation system, as seen from a traffic safety viewpoint;

b) Make suggestions as to how aligning performance measurement and outcome-based assessments could enable smarter strategic resource management and project prioritization in the deployment of transportation and traffic safety initiatives.

To do so, IBM applied a holistic analysis, with extensive desk and secondary research of global leading practices from other jurisdictions regarding intelligent transportation and urban traffic safety. We also consulted and conducted interviews with more than 70 City executives as well as the citizens of Edmonton. These discussions with stakeholders focused largely on traffic safety in the City and included police, emergency services, transportation, economic development and citizen advocacy such as Greater Neighborhood and Next Generation.

2.3. Edmonton Urban Traffic Safety

In 2010 there were 30 traffic fatalities with 5,203 people injured in the City of Edmonton as well as more than 360 road-related deaths in Alberta – an average of one per day. Every fatality is estimated to cost the taxpayer $1.2 million. More significant is the human toll.

Road Safety is a global problem with more than 1.2 million people killed on roads every year and by 2020 it is predicted that road fatalities and injuries will exceed deaths associated with HIV/AIDS.

For this reason, in May 2011, the World Health Organization launched the "Decade of Action for Road Safety" in an effort to save more than 5 million lives between now and 2020. The Plan is a comprehensive global campaign to "Make Roads Safer" concentrating particularly on the developing world. It is based on the safer system approach that has been adopted for many years in countries such as Sweden, Netherlands, UK and Australia and will focus on:

- Better road safety management
- Safer user behavior
- Safer roads
- Safer vehicles
- Better post-collision care.

http://www.makeroadssafe.org/Pages/home.aspx

It is Edmonton's vision to have the safest roads in Canada in support of the national road safety strategy which seeks to reduce the rate countrywide to no more than five fatalities per 100,000 head of population.

In 2006 the City of Edmonton established the Office of Traffic Safety (OTS). The OTS was the first of its kind in Canada and possibly in the world, with a mandate to using an evidence-based approach in integrating the four E's of traffic safety (Engineering, Enforcement, Education, and Evaluation).

OTS seeks to provide a coordinated approach to traffic safety in partnership with the Edmonton Police Service, the Department of Transportation, adjoining municipalities, transportation and police agencies, the Canadian Council of Motor Transport Administration (CCMTA), Transport Canada and Alberta Transportation.

Over the past 10 years the City has been building up its data assets and analytical capability. It has recently formed a cross-organizational and city-wide Traffic Data Co-ordination Council (TDCC), whose mandate, under the auspices of the City of Edmonton's Transportation Master Plan (TMP) is to:

"Proactively optimize the operation of the roadways in key corridors and areas of congestion using traffic management and transportation supply measures and focusing on evidence-based initiatives, to improve safety for all modes of travel and all roadway users."

— TDCC Terms of Reference May 19th 2010.

Edmonton City Council also approved the establishment of an Urban Traffic Safety Research Chair at the University of Alberta Faculty of Engineering. Furthermore, a Traffic Data Coordination Committee (TDCC) has been set up with cross-agency representation within the Transportation Department, the Edmonton Police Service and Information Technology and Community Services. The TDCC mission is to provide leadership, enhance communication and encourage network-sharing among the traffic data stakeholders. By doing so, it hopes to create an integrated traffic data system that meets the needs of all stakeholders.

2.4. Characteristics of Smarter Urban Traffic Safety

Countries that have successfully reduced road traffic risk are those that have embraced a "systems approach" to road safety. This approach looks at the traffic system as a whole and the interaction between road, vehicle, and road users in order to identify the potential areas for intervention. It recognizes that human beings make errors and that the road traffic system needs to accommodate these errors.

The current use of Intelligent Transport Systems (ITS) is often limited by a lack of an integrated and all-encompassing vision. Too often it is focused on a single means of transport using stand-alone proprietary systems.

A general definition of ITS is as follows:

"Intelligent Transportation Systems include the application of advanced information-processing (computers), communications, technologies and management strategies, in an integrated manner, to improve the safety, capacity and efficiency of the transportation system."

ITS applications can generally be divided into the following seven major functional categories:

- **Traveler Information Systems** – that provide real-time traffic and roadway information to travelers, allowing them to make informed travel decisions (for example trip timing, route choice, snow removal routes etc) and are delivered to the consumer through transport portals, online portals, smart phone applications and in car displays.
- **Traffic Management & Operations Center** – integrating multi-modal operations and affected parties such as emergency services, police, transportation authorities into one control center.
- **Public Transport Services** – including electronic transit schedule information, GPS tracking of bus movements and locations and Wi-Fi enablement.
- **Commercial Vehicle Operations** – referring to weigh-in-motion, electronic truck clearance at vehicle inspection stations and border crossings.
- **Emergency Management Services** – improving emergency vehicle response time by fleet-tracking, route guidance and signaling.

- **Vehicle Safety and Control Systems** – introducing in-vehicle technologies such as on-board computers, collision avoidance sensor technologies.
- **Information Warehousing Services** – for example, collecting traffic safety data and archived data management.

Some of the areas by which advanced analytics are used to improve urban traffic safety include:

- **Incident Management Systems** – directing traffic away from an incident, with faster incident response times, and reduced impacts on travelers in the immediate area.
- **Traffic Congestion and Prediction Tools** – integrating remote cameras, vehicle detection systems and time of travel to alert the control systems and manage traffic flow effectively using predictive analytics.

Citizens have a need for information related to their communities, their neighborhoods and their cities in general. Most municipalities are making dramatic changes to the way in which they provide this information.

Most citizens use technology in the form of smart phones, tablets and the Internet. Unlike yesterday's notion that very few people utilize technology, these devices have become standard pieces of equipment – almost an extension of the person themselves. Governments now have an ability to connect and communicate with their constituents like never before.

A direct example of this, and of relevance to the City of Edmonton, is the desire of citizens to have access to mash-ups that merge mapping, weather, road conditions, snow removal, road-closures and construction status.

The technology to make this a reality exists today. The benefits are two-fold. The ability to proactively communicate with the citizens by providing timely, relevant data, improves their quality of life. There is also a direct correlation between the citizen's perception of receiving such a value-added service and the development of a trusted, more connected relationship with the City.

2.5. Smarter Traffic Safety Maturity Model Assessment

IBM has used the Smarter Cities Maturity Framework to provide an overview of one of the City's key business drivers – how it is progressing in its traffic safety management goals.

The City has used extensive instrumentation across its transportation network, but has nevertheless found it challenging to interconnect those assets and fully leverage the data being collected for traffic safety purposes. While the Maturity Assessment has concentrated on this, it has also revealed other business drivers that need attention. Only when all of these drivers have been addressed can the City of Edmonton build upon its achievements to date and move towards a more integrated, truly responsive, dynamic and intelligent traffic safety system.

Table 1 provides a summary matrix of the path towards a city-wide overview of smarter traffic safety. It is based on the broader intelligent transportation maturity model. We have indicated where we believe Edmonton currently sits within this model.

Table 1 – Smarter Traffic Safety Maturity Model

Business drivers	Level one	Level two	Level three
Governance and accountability **Strategic planning** **Innovation and leadership**	• Departmental and project-based planning	• Integrated cross-organizational planning (single mode) ●	• Integrated city-wide planning, collaboration and innovation (multi-modal)
Performance measurement	• Minimal	• Limited mapping of KPIs to all levels within organization ●	• Continuous organization-wide, data-driven performance management
Citizen communication and collaboration	• Static web page, phone support, town hall ●	• Partially personalized content; subscription via user preferences	• Full customization, personalized, bi-directional, multi-channel
Data collection	• Manual, partially automated	• Real-time for major routes using multiple inputs for single modes ●	• System-wide across all modes, automated, real-time, wireless, fleet, sensors, location-based
Data integration	• Siloed, single department ●	• Single-source access	• Integrated, trusted datamart, cross-organization
Analytics	• Manual, ad hoc, descriptive analysis; data model generation ●	• High-level analysis in near real-time, predictive, optimization	• Real-time analysis incorporating predictive, prescriptive, geospatial, visual
Incident management	• Manual detection • Response and recovery	• Automatic detection • Coordinated response and manual recovery ●	• Video analytics, automated sense/respond, variable speed sign, smart information dissemination through multiple channels
Citizen information	• Static information • Online information via website ●	• Radio • Dynamic message system • Road sign redirection • SMS alerts	• Location based, multimodal proactive re-routing, crowd-sourced, bi-directional, cross channel including social media networks – Facebook, Twitter, blogs, etc.

● **IBM's assessment of the City of Edmonton's current state**

The model above does not take into consideration the broader maturity that the City of Edmonton has demonstrated in deploying predictive analytics within the EPS and Transportation Transit services.

3. Overall findings and themes

Realising the Way We Move vision will largely depend on how well the City of Edmonton embraces innovation in transportation and how citizens embrace the options for various commuting methods to support a more compact and integrated city. The City of Edmonton sees immense opportunities for decision making in using analytics to turn data into intelligence. By better understanding customer travel patterns, commuter behavior patterns can be influenced through incentives and transportation pricing mechanisms.

In addition, using traffic management measures to reduce congestion and delays can have indirect effects. The reliability and speed of the transit service can be maximized and emergency service and response times improved, with a reduction in overall carbon emissions. With Traffic Safety (engineering, enforcement, education and evaluation), the direct annual costs for collisions in the capital region can be reduced.

However, we believe that certain governance, technology and processes issues have created some impediments to the realization of smarter, safer transport.

Our detailed discussions with City stakeholders and select citizens identified some key issues. These cover five broad areas:

1. Data and analytics;
2. Governance and accountability;
3. Performance measurement;
4. Open data implementation;
5. Citizen communication (with regards to traffic safety initiatives).

The following section details these themes in more detail.

3.1. Data and analytics

IBM's engagement with the City of Edmonton has been partly based on discovering ways to use transportation data in a smarter manner, exploring the role that analytics could play in achieving traffic safety outcomes.

Our interviews uncovered several key findings that showed a failure to turn various data sources into intelligence, resulting in ineffective decision-making.

The key issues relating to data can be summarized as follows:

- **Data and systems inventory** – there was a common inability to locate systems and data, their owners and the managerial processes behind the data.
- **Data mart/data warehouses** – many were stand-alone, uncoordinated, or redundant.
- **Lack of a roadmap** – no integration points across organizations, project types remained unidentified, with no logical sequence of re-engineering and/or transformation initiatives in the company.
- **Lack of a data governance model** – there was no guidance, for example on data collection/analysis/dissemination, privacy, organizational alignment, and reporting.
- **Data strategy and data management** – initiatives were not linked to business priorities and needs.
- **Lack of business, technical, and operational metadata** – data quality, security/privacy/compliance, ILM, stewardship, and audit reporting disciplines were not supported
- **Skill set** – this was insufficient to support analytics.

While the City of Edmonton has invested in state-of-the-art technology (NC200 devices, Road Weather Information System (RWIS), Sensor Technology) and Business Intelligence software (BI) is utilized in several areas, limited use has been made of predictive and other advanced analytics.

By applying sophisticated mathematical algorithms, analytics can detect patterns, spot correlations and put data in context, thereby enabling a better understanding and control of transportation operations, development and planning. In relation to traffic and transportation, advanced analytics refers to optimization, real-time streaming or geospatial analysis of massive amounts of data sets.

Key issues relating to analytics and business intelligence include:

- Limited deployment of BI.
- Limited constituent utilization of business intelligence for real-time access.
- Existing infrastructure may be insufficient to support increased BI user base.
- BI, predictive analytics and geospatials are not integrated.
- Spatial Land Inventory Management application does not track infrastructure.
- Management strategy records do not exist.
- No analysis of unstructured and social media data sources.
- Video analysis does not use an analytics solution.

3.2. Governance and accountability

Governance

OTS is a relatively new organization, having been created in 2006. Given that there are very few direct comparables in other municipal jurisdictions, this approach to traffic safety especially for the City, is still at a relatively early stage.

When creating a new organization, it is often prudent to allow it to operate for a while to see if adjustments to its operating model are needed to increase its effectiveness. As the organization matures, some of its business and governance processes may have to be revisited, formalized and refined to enable it to work more effectively and deliver on its mandate.

In the case of OTS, one of the issues that has emerged since its creation is related to governance. Traffic safety is a broad-based mandate, which cuts across many silos and organizational lines of business. It requires a more holistic perspective, in order to adopt a regional approach both inside and outside the City's organizational structure. This was recognized from the outset, as seen in the original governance structure that proposed that the Office should report directly to the Council and the Police Commission through a steering committee of key stakeholders, including elected officials.

However, the initial proposal was not adopted and OTS was placed within the Transportation Department's organizational structure. As a result, in the absence of a more formalized, broad-based, governance model, OTS adopted an ad hoc collaborative approach to create a successful "systems of systems". This can be seen in the creation of a regional committee to provide greater coordination with surrounding municipalities. But despite these efforts, issues with coordination, resource deployment, and decision-making between the various key stakeholders still remain in some areas.

As a result, more attention to the governance structure would be beneficial to allow OTS to better fulfill its role, responsibilities and mandate. The form of governance should incorporate the principles of the Smarter Cities model: to adopt a multi-dimensional approach to planning in order to optimize both investments and the deployment of resources. Otherwise, OTS may have to rely on relationships to drive outcomes which may prove to be inconsistent and ineffective in the long term.

When first created, OTS was seen as a partnership between Transportation and the Police to provide an end-to-end systems view of traffic safety. However, having OTS report though a division in Transportation, arguably constrained its ability to assume a true partnership model. This, combined with the governance structure of the Police and its traditional at arm's length role, may have created a bias towards Transportation (notwithstanding the role OTS now plays in automated enforcement).

But even this original partnership model as envisioned for OTS could still be seen as too limited when considering traffic safety as a multi-modal, multi-disciplinary issue. Arguably, a true collaborative approach should involve a partnership with transit and other modes of transportation, as well as other disciplines such as Traffic Engineering and Road Design.

Notwithstanding the above, perhaps the greatest impetus for change at the present time is the fact that the issue of governance will become an even greater progress inhibitor as the City tries to move closer to the integrated management

of its transportation assets. Without integrated governance to both articulate and focus a vision for the future and create the mechanisms to enable it to become reality, progress will be slower and disjointed. A lack of coordinated decision-making and funding could lead to a potentially costlier model and lengthier roadmap in order to achieve its goal.

Planning

From a planning perspective, traffic safety requires an integrated multi-modal and multi-disciplinary approach. This includes the development of budgets, both from an operational and capital perspective. This is all the more important, given that capital projects often have an on-going operational cost post project. Outcomes have to be agreed, and key performance indicators established, to measure progress against those outcomes. As budgets are planned and allocated along organizational lines of business, this is often an issue. Despite this, both EPS and OTS have made progress on the planning front by developing a Joint Traffic Safety Plan. This involves funding plans (additional police squads dedicated to traffic enforcement being one example), key performance indicators, research reports, and conferences.

However, not all areas with a key stake in influencing traffic safety have been fully integrated into a formalized joint planning process. This disjointed approach may prevent the City from fully leveraging the investments it's making in traffic safety. It may also hinder the City's ability to establish an integrated performance management framework that includes jointly developed, multi-modal and multi-disciplinary KPIs.

As a result, the traditional organizational planning process may have to be amended in order to reflect this. The process should be tied to the performance management framework based on outcomes, with benefit owners and accountabilities clearly defined. A collaborative, more holistic, view should be taken to appreciate how disparate budgets can fund those common outcomes. Eventually, this may also result in the need to review or investigate new funding models, including self funding mechanisms.

Automated enforcement

In the current model, OTS has developed an operational role within transportation. Traffic enforcement is effectively divided between manned and automated enforcement. The first falls within the responsibility of the police while the second is largely dealt with by OTS. Given its expertise in traffic safety, arguments can be made for OTS to be involved in the purchase, installation, and maintenance of the equipment. However, its involvement in enforcement from an operational perspective may have some unintended effects.

By remaining in operations, the OTS may need to devote more of its "mind share" and attention to issues of operational management, contract oversight and engineering, and progressively build more capacity in these areas. With limited resources, this means that OTS could potentially have to reduce spending and investment in its core research and analytics mandate overtime.

3.3. Performance measurement

Alignment between departmental and corporate level traffic safety measures

The City has embarked on a very ambitious planning process that has taken a multi-dimensional perspective to define the plan for the City well into the future. One dimension covers the area of transportation and relates to The Way We Move. It is an outcome-based enterprise framework, with corporate measures tied to each outcome.

Despite the City's clear and articulate vision, concerns have been expressed about the large number of corporate-level measures used to monitor progress against corporate outcomes. Currently more than 90 have been identified. The effectiveness of reporting using so many indicators at one level of accountability has been raised, both from an operational and managerial perspective.

The City is now at the stage of identifying those departmental measures that tie into the corporate performance measurement framework. From a traffic safety perspective, only one out of four is attributed to safety (although not exclusively): "Transportation system is integrated, safe and gives citizens choice in their mode of movement".

The following two corporate level traffic safety measures are associated with this outcome: (a) the rate of transportation-related injuries per 1,000 population, and (b) the rate of collisions at intersections per 1,000 population.

However, the list of the nine departmental measures currently identified as part of the framework has no traffic safety related measures. This is a disconnect that will need to be addressed.

Data integration to support measures to evaluate progress against outcomes

Traffic safety has established the following four goals:

1. Reduction in serious injury/fatality;
2. Reduction in high-risk driver behaviors (95% seat belt wearing rate, repeat offenders, distracted driving);
3. Impaired driving (alcohol, illegal drugs, prescription drugs, cognitive impairment);
4. Speed management (safe system roadways).

However, identifying appropriate measures for each goal requires a certain level of data integration that is not yet in place, even though the data sources exist and are within the purview of the City. One example is the number of repeat offenders that have been ticketed for several traffic-related offences, by either manned enforcement or automated enforcement. This could be used as a proxy measure for the "Reduction in high-risk driver behaviors" and would require the integration of data from several databases, based on license plate numbers. However, in order to complete the analysis today, that process would involve many manual steps.

Lack of a formalized structure to link performance measures with a resource allocation framework

One of the biggest challenges in implementing a performance management framework involves both the identification of key performance indicators (what are the right ones and how many?) and establishing the right linkage between outcomes and enablers/activities that can support or influence those outcomes at the departmental and program level. As an example, the Canadian federal government uses a program activity architecture to report on performance including financials. Investment decisions can thus be reviewed from a resourcing perspective on both an organizational and outcome basis.

At the City, the implementation of the corporate performance measurement framework has yet to create the same linkage with respect to traffic safety. It will be important to adopt an approach that can establish the type of alignment described above. That approach should leverage the operational assets supporting the current business, including the chart of accounts and financial coding block, the analytics architecture, with its existing measures, data and applications.

By taking these assets into account when establishing the linkages within the performance measurement framework, it would better align the organization to deliver on the stated outcomes. Potential disconnects between the various operational reporting assets used to manage the business would be reduced or eliminated. Alignment of the outcomes, performance measures, targets, and financials is a precursor for more effective resource allocation decisions, whether these are related to operating or capital expenditures.

Change management and benefits realization

Given the level of change and potential disruption to the business that can take place when creating a new organization, this course of action generally represents a strong commitment and sense of urgency/priority to the mandate to be fulfilled by the new entity - and also indicates that the current organizational structure is either not well positioned to address that mandate in a distributed manner or requires dedicated resources as a focal point in order to support it. It also typically means a strong long-term commitment to the mandate of the new entity and the need for a sustainable solution that is permanently embedded within the structure and processes of the broader organization.

The above, of course, is true in the case of OTS, with one added dimension. By creating an organization with a broad-based mandate, such as traffic safety, which transcends traditional organizational boundaries, a cultural shift in the organization is required in order to be able to successfully operate using a multi-disciplinary collaborative approach as opposed to the traditional line reporting structure. Cultural changes are often the most difficult to successfully achieve and it would appear that there are still some challenges to overcome in this respect.

However, the case for change is anchored in the need to realize the benefits associated with both the investment the city has made by creating the OTS and the broader human cost associated with fatal collisions and injuries relating to traffic safety. But a benefits realization approach requires rigour in governance and process to ensure that accountabilities are well understood and a review and reporting process is in place to monitor progress. More broadly and practically, the benefits realization approach needs to be executed within the umbrella of a corporate performance management framework which the city is in the process of rolling out. In the absence of this, new capital projects won't be able or required to articulate their stated benefits, how they map to outcomes, how they will be measured and who is accountable for them.

More broadly and perhaps even more importantly, adopting a benefits realization approach using performance measures and targets, not only aligns the organizational investments with outcomes it also serves to strongly communicate the vision to the city taxpayer. In doing so, it narrows the gap between perception and reality for citizens by providing them with a clear outcome, target and measurement of performance.

3.4. Open Government – Edmonton Open Data Initiative

In January 2011 the City of Edmonton became the fourth city in Canada to launch an open data catalogue, making public information available to citizens and software developers in a machine-readable format. Last year, the City ran an Open Data apps competition for software developers to create useful programs for citizens. The City is releasing the updated Open Data Catalogue in early July 2011. This features quality data sets, geospatial data and self-service functionality and will use the Open 311 API to link the City Watch Pilot.

Our discussions with Councilors and City stakeholders have revealed that their Open Government and Data initiatives are undermined by the lack of a comprehensive data governance plan. They are struggling to keep pace with the rising momentum of resourcing requirements in terms of information to citizens. However, they recognize that significant opportunities exist to provide more information and apps to citizens on transportation and road safety matters.

3.5. Communication and Collaboration

In our discussions, City stakeholders and executives including Councilors were concerned about the current effectiveness of communications on road safety and citizen participation, despite the City supporting many local neighborhood communities including the Great Neighborhood.

The key issues raised included:

a) The current website is difficult to navigate, is not dynamic and does not allow for citizen feedback or collaboration. As a result the City gets a significant amount of telephone calls directly and via 311.
b) 311 is not mature and was originally developed as a call center operation only, unlike other cities such as Dallas and New York where 311 is deployed across all business units and is online driven – with smartphone apps and the options of texting.
c) Current data collection methods for road safety research and assessment of initiatives rely heavily on traditional data collection. Thus the participation of some segments of the community is limited.

Example:

"311 has been a miracle. It has been a Godsend for us," says Ed Harris, Emergency Communications Director for the Austin Police Department, which launched its program a week after September 11. "311 saved us not only from having our 911 system swamped, but saved our citizens who had true emergencies, such as heart attacks."

4. Recommendations

City transport authorities are investing in an increasingly complex IT portfolio to support the provision of their transport networks and the rising level of instrumentation needed to manage traffic enforcement. There is now a real need and opportunity to align their IT architectural framework with the business strategy and operational model, to achieve a greater degree of integration in system, data and service.

IBM believes that an integrated common framework uniting some of the key transport sub-systems, offers City transport authorities the ability to manage their network better and to provide customers with integrated services.

This framework should make maximum use of open and common standards as well as adopting a web services architecture that simplifies future integration and inter-operability between transport systems.

For the City of Edmonton we refer to this model as a "smarter traffic safety framework". It is summarized in Figure 1 below.

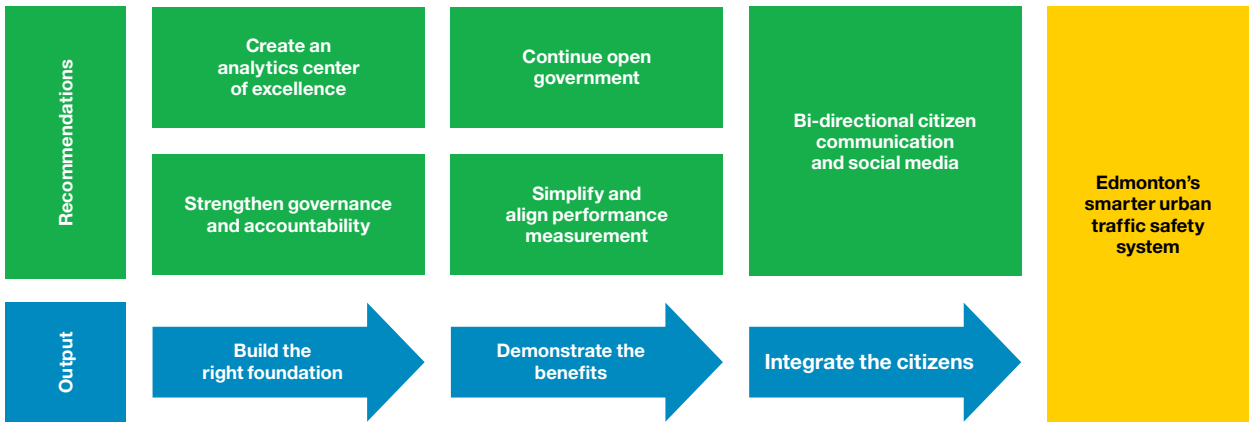

Figure 1
Smarter traffic safety framework

In summary, we are proposing that the City should focus on the "enablers" to achieve global leadership in urban traffic safety and include the following:

1. Create an Analytics Centre of Excellence to support a road safety data governance model and analytics leadership across the organization;
2. Strengthen governance and accountability with respect to OTS;
3. Further support open government and open data for traffic safety and transportation;
4. Simplify performance measurement of the City's strategic plans for transportation;
5. Empower citizens with timely traffic safety and transportation information via social media and bi-directional citizen communication;
6. Aggressively position Edmonton as a global leader in smarter urban traffic safety, to include collaboration with global leaders in the industry and academia to identify a unique traffic safety/transportation research project.

4.1. Create Analytics Center of Excellence

To overcome the issue of data governance and analytical competency with regards to traffic safety data, we recommend that the City establish a dedicated Analytics Center of Excellence (COE). The COE should align IT closely with the analytics organizations to build technical assets based on analytical solution requirements for the traffic safety business. It would act as the "single point of truth" and first line of interaction for analytical support queries.

The COE function will greatly assist OTS with its plans to lead in urban traffic safety research and policy development, since its data assets will be better managed and communicated across the organization and to the community.

A COE is normally staffed by one or more data architects whose role is to understand how to map, organize and plan the use of data for the transportation portfolio. This includes the extract, transform and load activities (ETL).

More importantly, we would suggest the appointment of a Chief Analytical Officer (CAO) to manage the function and be ultimately accountable for adhering to the data governance assessment and managing advanced analytics for transportation.

"The City of Edmonton's strategic planning work is setting us on course to become a top-tier city, but enhancing our capacity to collect, analyze and act upon information is critical to our success."

— City Stakeholder

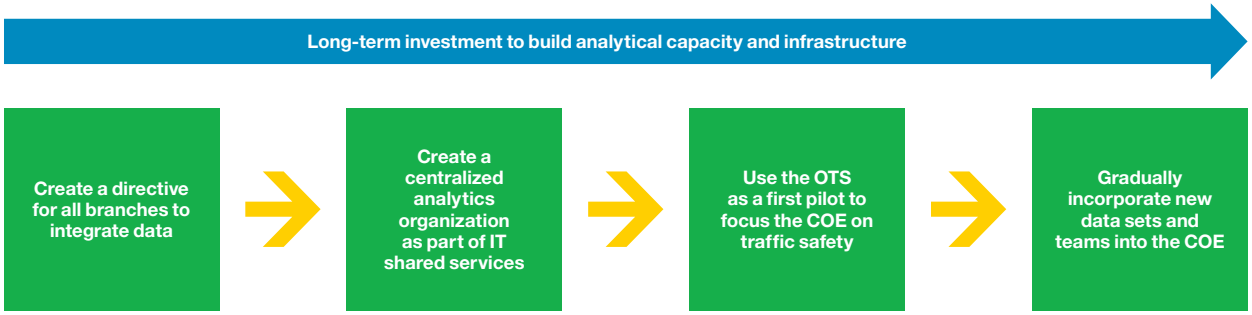

Figure 2
COE Roadmap

Action: Create a policy directive requiring all branches of the City to integrate data

To ensure that all relevant data is included in the integration process, there must be agreement and support at all levels to make this a priority. Issuing a directive will serve to empower the COE in its efforts to gain access to those data silos that should be integrated.

Action: Design the Analytics Center of Excellence (COE) organization as part of IT shared services in analytics

In order to ensure access to required skill sets and resources, placing the COE in IT shared services will help avoid resource competition and project priority disagreements.

Action: Use the OTS as a first pilot to work with the COE and integrate their data

At present, OTS collects a vast array of data that cannot be assembled to form a complete picture for traffic analysis. Documentation of these data sources is already under way. Making OTS the initial integration project would showcase the benefits derived from a single trusted source for analytics.

Some of the key objectives of the initial pilot would be to:

1. Build a rapid prototype of a simple, small-scale analytics solution;
2. Transfer BI tool selection insights and overall process knowledge from ETS and EPS;
3. Understand how to map a business question/requirement down to the data level;
4. Understand how to build data models for use in analytics;
5. Establish correct mechanics of end-to-end process of building analytics solution;
6. Understand how output might be disseminated via multiple channels to different customer types;
7. Understand challenges and strategy of scaling analytics projects;
8. Develop plan to roll out to remainder of the organization;
9. Establish ownership roles and responsibilities;
10. Select, deploy and utilize version control system.

To be effective, the COE function would eventually be rolled out throughout the organization.

Action: Establish a data governance plan aligned with Edmonton's Enterprise Architecture to support traffic safety analytics

One attribute of a Smarter City relates to the optimal use of all available interconnected information to understand and control its operations better and to optimize its limited resources. An expected result of the transition to becoming a Smarter City is the proliferation of accurate data throughout the enterprise. In the context of Edmonton's traffic safety programs, its progressive, innovative, experimental culture has naturally resulted in piloting the use of devices and new technology that generate data from sources such as sensors, meters, cameras, structure and unstructured data, as well as crowd-sourced data.

Like many other cities, Edmonton's data is collected, analyzed and disseminated primarily for single, independent departments or organizations. It is a near-term imperative to span these silos to get a complete overview of the data, to answer traffic safety related business questions and conduct research.

To become a Smarter City requires a fundamental change of perspective in the way the City thinks about and manages its data assets. At the highest level of data management, adopting a data governance model will guide the City's data management resources.

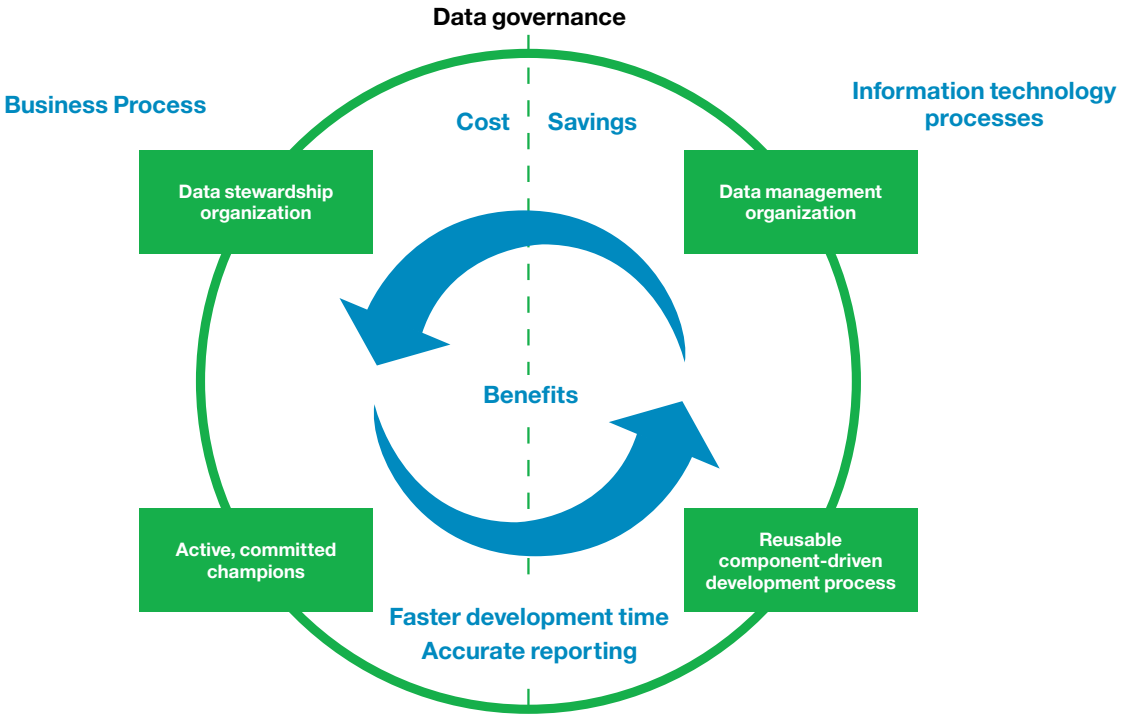

Figure 3
Data governance model

The benefits of a data governance model are to:

- Provide an organization with an informed, objective, documented assessment of its maturity within a data governance maturity model.
- Give actionable insights into the various disciplines within data governance, including: value-creation, organization alignment, data architecture, security/privacy/compliance, information lifecycle management, policy, risk management, data quality, stewardship, audit and reporting and meta data/business glossary.
- Break down silos that are the result of having many stand-alone, uncoordinated or redundant data mart/data warehouses.
- Facilitate common and standard data domain definitions, architecture practices and standards.
- Help connect operational activities with corporate business performance.
- Enhance and enables development of enterprise-wide strategic solutions.

Without data governance, the amount of disorder within an enterprise increases over time as processes and systems move in opposite directions from one another.

The role of the TDCC in data governance should be to ensure a consistent, coordinated, ongoing focus on the alignment of the City's resources to deliver value through its data management efforts.

The role of the COE should be responsible for the data governance assessment and deployment.

Figure 4 illustrates the linkages between data, analytics, and corporate decision making.

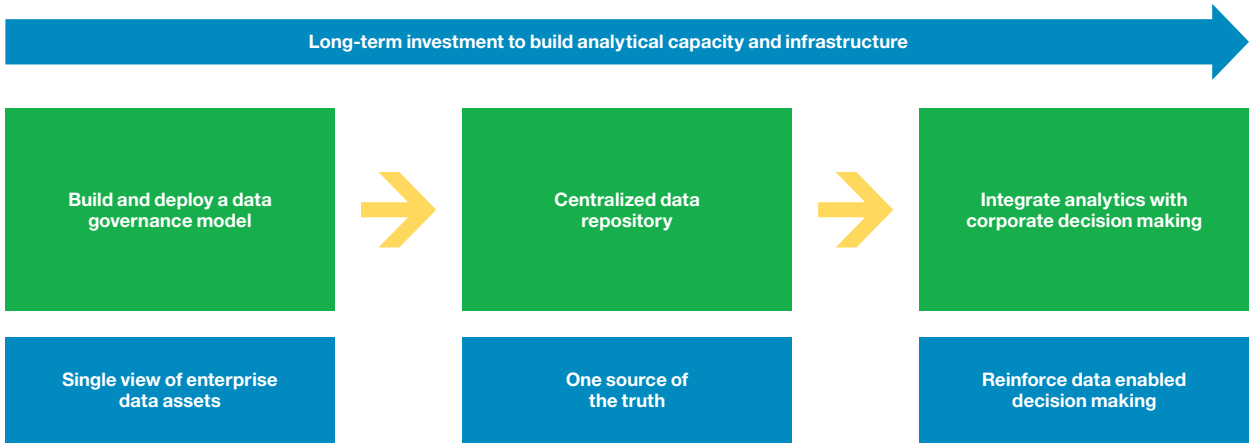

Figure 4
Linkages between data, analytics, and corporate decision making

Action: Adopt a best practice analytics architecture

The architecture described below provides the ability to analyze data in the round and visualize results on any device throughout the city. It naturally supports the use of web services to build advanced analytics tools. As a result, commercial off-the-shelf (COTS) or internally-created analytics tools can be used to create highly customizable applications for internal or external (public) customers conducting multiple forms of deep analytics.

We also suggest considering the use of visualization for constituents, enabled via real-time interactive traffic-related reports and dashboards. These would feature user-selectable data fields, filters, sorts and standard report layouts, all operating in a real-time mode against the trusted central data repository (Figure 5).

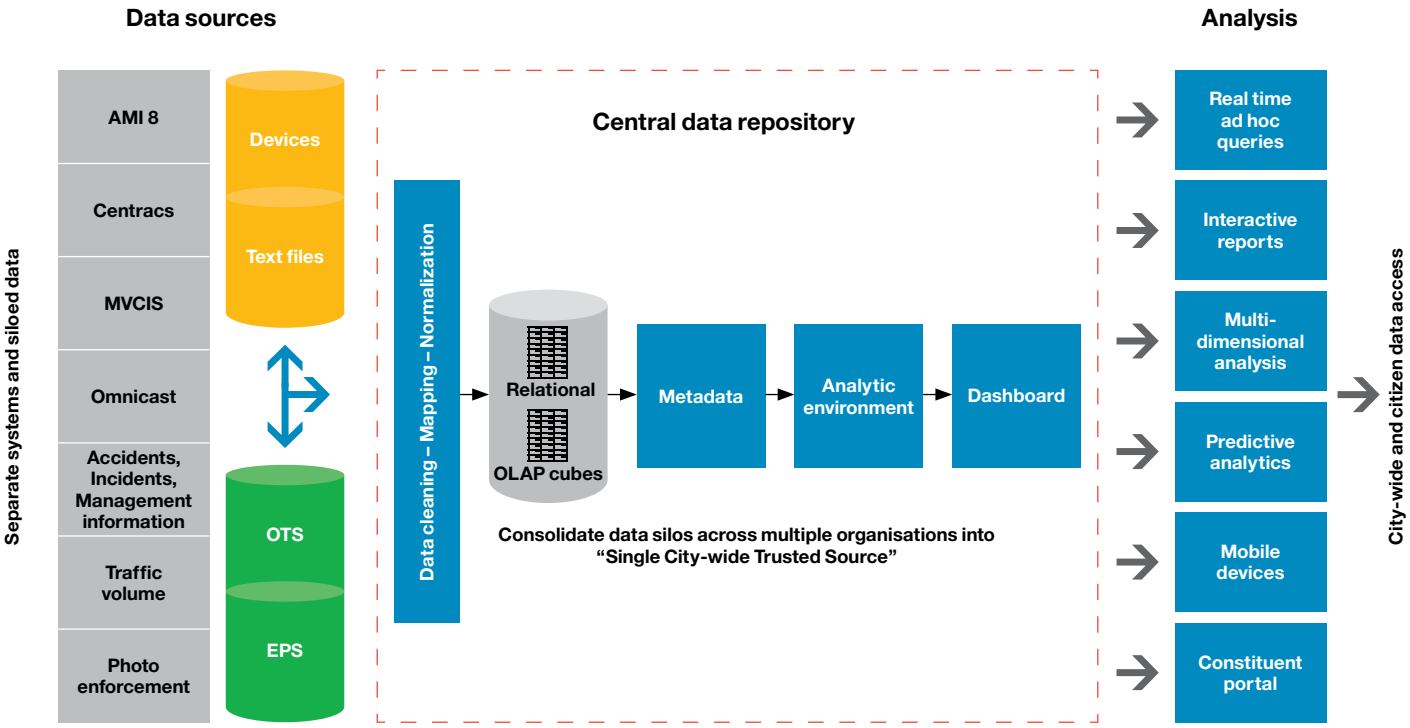

Figure 5
Recommended analytics architecture

Action: Develop an advanced analytics framework to drive interconnected and intelligent traffic safety solutions including:

- Extension of BI user community within the City and out to citizens.
- Incorporation of predictive analytics into the architecture.
- Integration of analytics with geospatial solutions.
- Adoption of a scalable, fault-tolerant architecture.
- Utilization of predictive analytics as a survey and analysis tool for citizen feedback.
- Implementation of a records management strategy and platform.
- Use of content analytics to mine unstructured and social media data.
- Inclusion of video content into the analytics process.

Action: Consider the public as a data source for crowd-sourced data collection and location-based solutions

The ubiquitous nature of mobile phones, location-based services and the propensity of people to utilize social networking tools has given rise to a number of very intelligent solutions using crowd-sourced and location-based technologies. Such solutions can:

- Off-load responsibility of data collection that may not exist, or might otherwise be under the control of paid staff. http://www.ibm.com/smarterplanet/us/en/water_management/article/creek_watch.html

- Combine a person's established travel patterns with real-time data collection from highways to predict what traffic conditions will be like for a given road segment at a particular time of day. The first pilot based on that scenario was completed earlier this year.
  http://asmarterplanet.com/blog/2011/04/a-smarter-traveler-in-a-congested-city.html

  http://fastlane.dot.gov/2011/04/partnership-can-predict-traffic-and-let-you-know-before-you-drive.html

Similar solutions for the City could be built to produce longitudinal "pulse surveys" of the City at lower cost, to analyze the public's attitudes to public transportation and safety, and the use and condition of the City's roads, to name a few. This "crowd-sourced" approach to data collection and solution development could be combined with the City's Open Data and Open Government initiatives to increase the visibility of City services and promote a more collaborative, community culture.

Action: Exploit advantages of cloud computing

There are many advantages and uses of cloud computing. Edmonton has already begun using the cloud to store various types of unstructured and structured data. The cloud is also a key component of the City's Open Government initiative, as it enables the use of other "open" data sources and tools, such as mapping, visualization and social networking. Exploiting these advantages will enhance Edmonton's image as a leader in Open Government, enable a rich user experience through the use of mash-ups and web-based interactive analytics tools and increase the effectiveness and speed in which the City can disseminate information.

As the City develops its own analytics competency, the cloud can be very helpful in decreasing IT procurement cycles, managing the analytics application lifecycle (build/test/deploy) and automating the scaling efforts of analytics applications.

Other data-related actions:

Map business requirements to data

- Requirements should be mapped all the way down to the data being collected. Similarly, collected data should be capable of mapping back up to KPI's and metrics that have data dependency. This will be critical for the traffic safety performance measurement.

Automate all data collection

- Where manual, paper-based data collection exists (such as collision reporting), migrate to a tablet approach for police officers to capture this data digitally. Doing so will ensure that the data follows pre-determined workflows, is added to the central data repository and becomes immediately usable by other analytics processes.

Adopt data and architecture standards

- Implement standards for naming conventions and file formats wherever possible to help establish an open environment, facilitate interoperability between future and legacy systems and create new opportunities for innovation and value creation.
- Open standards must be the foundation for a data modeling framework. Make use of existing standards such as the Open Geospatial Consortium standards (OGC.org) and OpenGIS® interoperable solutions that "geo-enable" the Web, wireless and location-based services and mainstream IT.

Build a career development program in advanced analytics

Implement a program for City analysts to broaden the application of advanced analytics and deepen collaboration with the University of Alberta as well as other global traffic safety and transportation research centers.

Additional data-related considerations

Visualization is a key element of the infrastructure, both to convey complex data effectively and also to enable non-experts to make full use of the relevant features of the infrastructure. A visualization environment with a strong data model is needed to enable visualizations, model results and allow relevant data to be handled similarly.

Consideration should be given to extending dashboards, ad hoc query, analysis and reporting across the various traffic safety stakeholders. Infrastructure considerations including cloud should be taken into account as business intelligence utilization increases. Scalable, fault-tolerant and load-balancing server farms will take advantage of features built into many BI technologies to facilitate an available and efficient user experience across the city.

Depending on the data and the user type, whether commuter, engineer or police officer, this could take the form of published reports sent to mobile devices via the Web or published to the city's internal and external websites. Structured ad hoc query capabilities involving the application of filters, sorts, and field selection could be provided to constituents. Many cities now offer this as an interactive option for accessing city data. Council members could also benefit from scorecards and strategy maps – a key component of most business intelligence suites, to reflect key performance measures and convey cause and effect.

In addition to expanding the footprint and reach of business intelligence, the City's five-year plan should be executed around predictive analytics to accelerate the integration of both technologies with geospatial analytics. The result would be a map interface that would have links to real-time business-intelligent queries and reports with the ability to predict outcomes. At least one predictive analytics technology would also facilitate web-based survey delivery and subsequent response analysis. This would address increased constituent outreach.

A comprehensive approach to records management is also strongly recommended for the City. The ability to catalog, search and establish a retention plan for both digital and paper-based document assets has been adopted by many cities aiming to comply with established industry standards such as DOD 5015.2 and ISO 15489. Taxonomies and indices allow categorization of documents for optimized search inquiries. Each document should have an archive date and disposition (offline archival versus destruction) to ensure only required data is retained and safeguarded according to an established best-practice approach. This approach will ensure compliance with any mandatory or precautionary audits.

An abundance of data exists in non-structured formats such as word-processing documents, spreadsheets and text files. As technology has evolved, the list has been extended to include social media content such as tweets, chats, blogs, Facebook, Twitter and other means of digital communication. The ability to mine untapped data from all of these sources has become a priority of most business and governmental entities. Content analytics provides this capability by allowing these data sources to be extracted. Dashboards and reports can reflect the repetitive occurrence of keywords to determine constituent sentiment on a given issue or topic. Unstructured document sources can be trawled for information in a manner similar to a database.

4.2. Strengthen the governance structure for OTS

Action: Establish a multi-disciplinary advisory board to support OTS

In order to enhance the City's traffic safety resources, OTS needs to have a stronger governance structure that better reflects the multi-dimensional nature of traffic safety and the fact that its mandate transcends traditional organizational boundaries. Originally, OTS was envisioned to report to the Council and the Police Commission through a steering committee that included the Police Chief and GM of Transportation. For a variety of reasons that structure never materialized. We recommend creating an Advisory Board for OTS, co-chaired by both the GM of Transportation and the Chief of Police as the formal restoration of the partnership model originally conceived for OTS.

The advisory board membership should include a holistic, regional network-wide and multi-modal perspective in order to be truly reflective of the nature of traffic safety. The membership could include the RCMP (to reflect the policing activity that takes place in surrounding municipalities), transportation representatives from adjacent municipalities, the transit organizations, planning, the research chair at the University and the Executive Director of OTS.

Although the details and mandate of the advisory board would have to be determined, it could meet quarterly and have a standing agenda that includes data sharing, cooperation issues, and review of the progress against agreed-upon performance metrics.

Action: Restore the original mandate of the Office of Traffic Safety

For several reasons, Edmonton's Office of Traffic Safety (OTS) has expanded its scope of responsibilities beyond the original mandate by managing the operations of the automated enforcement program. As an analytics, research and coordination organization, this has arguably diluted its mandate and shifted resources and attention to equipment administration. It is therefore recommended to move this responsibility outside of OTS to allow it to reassume its originally conceived role and focus on research, advisory services, and the coordination of the City's traffic safety activities.

Action: Establish cross-branch membership within the OTS

In addition to creating an OTS advisory board at a more strategic level, we also recommend introducing cross-organizational collaboration at a tactical level. More specifically, we suggest reviewing the feasibility of integrating traffic safety analysts in other lines of business, such as with EPS. Although the analysts would still remain with their current organization, they would be integrated from a data and analytics perspective in order to promote collaboration and cross-functional knowledge transfer.

Action: Select public champions with high public visibility

In order to raise the profile of traffic safety and visibly demonstrate the singular integrated governance approach taken by the City, a highly visible public figure from outside the City could be selected to champion the cause. This could create the type of external focal point for the issue as well as personify it for the public.

Benefit

- The above recommended actions will set the governance foundation required to integrate the management of all the traffic safety assets. The full potential of the City's investments toward promoting greater innovation and accelerating the path to Vision Zero will be realised.
- It will help in coordinating planning and funding, and addressing issues as they arise in a more deliberate and systematic manner.
- It will promote collaboration and knowledge transfer.

Outcome

- By coordinating efforts towards a common outcome, an accelerated path to Vision Zero will avoid duplications, re-work and potential throwaway investments, thus streamlining costs, efforts and resources.

4.3. Further support open data for traffic safety

Action: Develop an Open Government Policy Framework for the City of Edmonton based on the Local Open Government Directive (US) and embrace ideas from other cities with regards to transportation open data (UK, New York, Kyoto, Helsinki)

An example of local government implementing effective open government for its citizens can be seen in the Local Open Government Directive. This includes representatives from the Unites States – Denver, CityCamp, Colorado Smart Communities, the Code for America, the Sunlight Foundation, Open Plans and others.
http://opengovernmentinitiative.org/wp-content/uploads/2011/01

For Edmonton we suggest that the City specifically accelerate its open government agenda by:

- Developing a formalized, long-term, sustainable open government policy framework.
- Developing a deliberate and planned roadmap to determine frequency of dataset refreshes.
- Developing a targeted communication strategy to inform citizens of when new datasets will be released, including geospatial information. Such a strategy could include the use of RSS feeds to allow a user to subscribe to the desired content and updates.
- Dedicating resources to engage with industry and software developers for new applications. Expand the eco-system of road safety communities of interests to generate new ideas, applications and use of data.
- Providing feedback loops on data generated by the community in terms of applications, uses and interfaces for traffic data.
- Providing datasets on the website so developers can develop free-form applications and request additional datasets.

Action: Establish a roadmap for release of traffic safety data (OTS, transportation, crowd-sourcing)

- Prioritize available traffic safety related data.
- Determine the frequency of data refresh.
- Identify level of effort required to maintain data sets and staff accordingly.
- Develop approval and quality assurance processes for releasing the data – including what level of data needs to be aggregated and the optimum method of publication.
- Integrate with geospatial data and develop overlays for location-based datasets.
- Seek to redesign the City of Edmonton transportation websites for citizens and include integration of 311.
- Create a dedicated, open portal for the OTS to encourage new applications for initiatives in transportation, road safety, associated community/neighborhood engagement, and education.

While the City of Edmonton currently supports open government and has released the open data catalog, we believe that it should consider ramping up new applications and service portals with specific information on transportation and road safety. This content can be merged with other relevant data including weather, road work and construction schedules, transit timetable scheduling, pedestrian walkways routes, and bicycle paths.

The case for open government

An open government makes the impersonal data and information it holds available to the community. It shares what it knows about its citizens. This information can form the basis of much deeper engagement within government and the wider community.

A clear benefit of open government for Edmonton's citizens, business and organizations is the ability to develop a more profound understanding of government operations, including service delivery. Its people will be able to participate in offering constructive suggestions about any areas of change in government decisions and services relating to urban traffic safety and transportation. Communities will have the ability to collate sets of data and information (crowd-sourcing). The information will then be made available for stakeholders to use. They will be able to leverage technology to "mash up" the information with other data sources. This will allow the development of interesting insights and observations on citizens' responses to transportation and road safety-related information.

In return, the public, having greater access to government and transportation-related information, will greatly enhance evidence-based policy making.

In an environment of collaboration and creative and innovative leadership, access to anonymous government information will be important. Unless they have full access to this data, governments and the wider community will not be able to see or understand the impacts of their policies and programs in a "systems of systems" approach.

The move towards open government has accelerated in response to a digitally-enabled society, with many implications, for example:

- **New business models** – from being a retailer of information and services, government becomes a wholesaler of information, allowing users, industry and other agencies to develop mash-ups and applications for multiple devices. This presents an enormous opportunity for us all.
- **Authority** – giving public servants the right to engage, using common sense in what they are and are not authorized to say. Nothing, however, should stop them from gaining valuable insights into what matters most in their community.
- **Crowd-sourcing** – content producers come from everywhere.
- **Citizen interfaces and devices** – know your audience and use their language, to deliver content to multiple devices. Provide the right content to the right people at the right moment and choose the right platform for the message (for example – VicRoads, iTunes and how to obtain a license).
- **Local solutions** – citizens want local solutions – for example, information on road closures in local areas to allow people to plan their work-route. This is valuable and having this linked to a mobile device is even more valuable.
- **Resourcing** – with the increasing complexity of information available to public servants and citizens, the considerable resources required to create, publish and maintain information and services will inevitably come under pressure – adding to people's current workloads. Putting relevant technology to use, such as adopting standards and open file formats, filtering, indexing, search, archiving and storage, should minimize these pressures.
- **Citizen engagement in public policy** – local government needs to go beyond traditional locations to people in the home and direct them to its website to seek information and conduct transactions. As both citizen interest increases and technology improves, the foundation of "deliberative democracy" grows.

The "how to" for open government

- Enhance the accessibility of government information online – including smart phones, wireless devices, Twitter, Facebook, YouTube, wikis, forums and blogs.
- Review and advise on Web 2.0 and Web 3.0 practices. For Web 3.0 (the semantic Web) we refer to the tagging of datasets to enable sharing and re-use of data, allowing both citizens and developers to create new generations of "linked data" mash-ups.
- Review copyright and intellectual property barriers to open data sharing.
- Categorize data as private or non-private and then prioritize release of non-private data.
- Encourage community, citizen and developer to elicit new ideas from the community on Government 2.0.
- Use Digital Media (geospatial, 3D, multi-media) – lots of information in an ever-increasing range of formats, to allow the display of geospatial information in innovative ways, providing real-time situation maps for major disasters and events.
- Digitally enable citizens to have access to wireless, broadband and internet services anywhere, anytime and from any device, whether at work, at home, in their cars, throughout various forms of City transit or the City as a whole.

4.4. Simplify performance measurement

Action: Simplify corporate level performance measures and align departmental and corporate traffic safety measures

Given the concerns shown on the high number of corporate level measures, the City may want to revisit its approach and streamline these metrics. At this point in the implementation, there may be limited opportunity to engage in this discussion. However as time goes on, a change process will need to be developed, in order to continuously improve the framework as time goes on. Consideration should be given as to whether this should be a quarterly or annual process.

In terms of the department, there is a need to address the disconnect between corporate and departmental level traffic safety measures. This means that at least one of the nine measures identified should relate to safety. Work should be initiated with OTS and more broadly within the department to ensure this is addressed with the objective of aligning measures to deliver outcomes.

Action: Review data sources and integrate relevant data to support traffic safety measures

Data integrity is at the foundation of performance measurement. Given the known issues of conflicting figures when calculating measures or the lack of data integration, the City will need to establish a single source of truth for its data – with priority given to those data elements supporting performance measurement.

Action: Establish a clear link between performance measures and resource allocation

As the City proceeds with the implementation of the performance measurement framework, traffic safety has the opportunity to be at the forefront. By aligning its human resources, processes and technology, it can adopt a comprehensive approach to both performance and resource allocation.

As a first step, the OTS needs to formalize those core program activities that support corporate outcomes, define the measures used to assess progress, and determine targets to be achieved. This should be an activity integrated with its partners, the police, transit and any other relevant City stakeholder. A formalized documented planning process should be established, similar to the joint OTS/EPS planning process, but broader in scope. As a starting point, the OTS should use the four goals outlined earlier.

The OTS and participating stakeholders in the planning process should then determine how to align and capture spend against these goals, measures and targets. In order to do this, they will have to review how costs are currently captured in the financial system of record, and identify the changes if any, that are needed, to better understand the impact of their investments on traffic safety. Once completed, a consolidated view of the City's total investment in traffic safety from both an operational and capital perspective can then be monitored against outcomes.

The OTS could also strengthen the alignment between the performance measurement framework and its management of human resources.

Clearly defined outcomes, measures, targets and accountabilities provide the individual with a better understanding of their contribution to the organization's strategy. However, to formalize this alignment, potential changes would need to be made to personal business goals, performance appraisals and personal development plans. Everyone – not just the organization's leaders – would need to concentrate on the outcomes and the measures used to assess progress. The role of the performance framework would be important in this respect, acting as a strong communications vehicle to focus the organization, its resources, investments and individual efforts toward the achievement of common goals.

Once OTS has aligned its measures, financials, and targets, it has the foundation to provide leadership in the use of BI software for the city. It could be the first to design a business intelligence architecture, to put its performance measures and a resource allocation model into action. BI suites have the capability to integrate both financial planning and "what if" scenarios as well as map performance measures. The OTS could leverage the City's investments in BI software and use that functionality to accelerate more effective decision-making and resource allocation – thus becoming a model for the rest of the city.

Benefits

- Sets clear outcomes, targets and performance measures to articulate clearly what has to be done.
- Aligns and reallocates resources, both internally and externally, to work toward common goals.
- Identifies gaps in data.
- Provides transparency and visibility on the linkages between investments and outcomes.

Outcomes

- A common "call to action" to align resources toward a shared goal. Full transparency would ensure that all stakeholders have the same understanding of what efforts and resources are required to achieve a given outcome.

4.5. Two way citizen communication and social media

Action: Empower the citizen with the right information at the right time using their preferred channel/device to help them make informed and rational decisions about their travel

Information to the traveler should be provided to help with:

a) **Pre-trip planning** – avoid traffic delays by suggesting alternative routes, transit schedules, snow and weather conditions, construction work, snow removal schedules and status, events or incidents;
b) **Network issues** – Curb the Danger, report accidents, make alternative routes depending on traffic conditions, location of speed cameras, road crossing locations, changes in dynamic speed limits;
c) **Post-trip** – provide feedback via Pulse Surveys, Twitter, blogs and suggestions for necessary data.

Underpinned by:

a) Bi-directional communication, feedback loops and pervasive use of social networks, media and new applications for smart devices;
b) Ongoing Pulse Surveys to establish how citizens like to get information and their own suggestions to encourage the use of data that is important to them.

Benefits

- Immediate value is derived when you create a citizen-centered model. Ownership of road safety is placed within the community which feels engaged to make a positive difference to the cause.
- Enables the City to improve its road safety analytical capabilities on the fly – dynamic and crowd-sourced.

Outcomes

- Added safety for the citizen, reduction in incidents, raised awareness of traffic safety, education for the citizen, targeted, dynamic and pre-packaged real-time information.
- Branding of the City as safe, dynamic and connected with citizens.

Action: Investigate process improvements to further develop communication channels such as the City website and 311

1. Leverage 311 as a key channel for citizens to engage in road safety issues and management (similar to Dallas Texas 311);
2. Enable users to submit requests via SMS;
3. Enable users to receive alerts via sms against user profiling preferences – For example receive bus schedule changes alerts via sms;
4. Download mobile apps for crowd-sourcing related to road and traffic issues such as Curb the Danger (impaired drivers) and potholes – new features of the 311 service – citizen demand;
5. Extend current open data sets to 311 as they relate to traffic and road issues.

The case for two-way citizen communications

A city focused on its citizens looks to address their needs by providing information and access to city services in a convenient and easy-to-use manner. When done right, both the citizens and city government can benefit. This mechanism gives citizens access to the information and services they need while the city has means to share important information and obtain input easily from its citizens.

There are several government entities that have created simplified, effective communication models which contain easy-to-locate data. One of them is the United Kingdom (http://data.gov.uk).

There, they have developed a citizen-centric model with headers that make it easy for citizens not only to navigate their website, but interact with a government that has chosen to make transparency a priority by highlighting it on the home webpage.

Additionally, the government encourages application developers to engage by providing over 6,900 datasets, of which 100+ applications have been built. Citizens not only have access to this data, but are provided with an area to push their applications to the community (or share), as well as a method of requesting additional data.

There are also forums, wikis and blogs on the site. Citizens are encouraged to submit their ideas, and other citizens can collaborate or comment on them. A collective voice is heard through this process.

On several pages, they have included a "tagging" feature which illustrates the most highly accessed areas within the site. Also, citizens can subscribe to RSS feeds as well as recommend the site to others via various social media such as Facebook, Twitter, etc.

The result of this type of site design is a high level of bi-directional communication and increased government credibility.

Example:

For traffic safety an example is the Sygic real time traffic for GPS application. This provides up-to-the-minute traffic information on traffic congestion and other road conditions and is pushed directly to smart devices. Subscribers to Real-Time Traffic receive up-to-date information about traffic accidents, road closures, traffic congestion and major road works. Suggesting alternative routes helps commuters to avoid long traffic delays by http://www.sygic.com/en/real-time-traffic-for-sygic-gps-navigation-apps-launched-in-australia

4.6. Aggressively position Edmonton as a global leader for urban traffic safety

Action: Collaborate with global leaders in industry and academia to identify a unique traffic safety/ transportation research project

In order to raise the global profile of Edmonton's efforts around transportation and traffic safety, we recommend that the City leverage OTS's unique status as a separate entity from municipal police. It should collaborate with City stakeholders (OTC, EPS), private sector partners and local and provincial universities in identifying a transportation management or traffic safety problem that is truly a global "first". This effort will support the City's plans to attract leading global conferences to Edmonton.

Action: Host global virtual portals events and think tanks

The City should establish and run real-time, multi-day virtual, collaborative events that are open to those citizens or organizations worldwide that may have expertise with application development or are interested in the City's issues. Such events would foster citizen involvement and encourage input from those that choose to get involved. They can be planned to coincide with trade conferences hosted within Edmonton or those conferences that Edmonton attends outside the city. The result would be a collection of ideas from the public that can be analyzed, combined, prioritized and ultimately acted upon to improve City services and citizen involvement.

Action: Set a bold vision of smarter urban traffic safety and management innovation and technology

OTS has outlined a set of practical solutions on paper that sets the direction for advancing the City's use of analytics. While the City should pursue these solutions, it should also consider how to enhance their vision and value. For example:

- Linking cross-organizational operations via web services to enhance value.
- Utilizing crowd-sourced data as inputs.
- Interfacing and using social networking tools.
- Utilizing web services to create mash-ups tailored to specific end-user types.
- Integrating fast-track geospatial analytics to include data relating to locations for incidents and hot spots.

An example of some of these design considerations are illustrated in the following theoretical, yet practical solution:

Descriptive analytics is applied to build data models in order to determine the optimal speed for road segments and bridges, under a variety of weather conditions. Predictive models are built to predict when actionable conditions will emerge within the transportation system, caused by changes in weather patterns. Streaming analytics could analyze Road Weather Information System (RWIS) data and LTS bus tire traction data in real time. As weather conditions meet predetermined criteria, prescriptive analytics could be used to determine the optimal speed for roads and bridges, with automated changes being made to variable speed or message signs. Delay information could be disseminated to travelers via multiple channels before they begin their journey, with recommendations for public transit alternatives and their status (on time, delayed).

Edmonton has the predictive analytics capability as demonstrated in EPS and Transit. The same competency could be broadened into the traffic management center to shift from a real-time variable message board to fully operational sense-and-respond capability.

Additional actions could also be triggered that further benefit and optimize multiple organizations within the City.

5. Conclusion

Edmonton is expected to experience continued economic and population growth, largely driven by increased exports in oil, gas and other resources, the education sector and tourism.

As the City shifts from the traditional resource-based economy towards a more diversified "knowledge" economy, new ways to improve the reliability, safety, efficiency and responsiveness of the transportation networks will be required to cater for freight, road travelers, public transit citizens, pedestrians and cyclists.

Given that there has been a recent shift away from funding and managing large road infrastructure projects across the City, there is now more pressure to optimize the existing transport network without compromising safety and efficiency.

Edmonton's ability to support a "smarter traffic safety system" will be largely dependent upon the City's capacity to deploy an enterprise-wide data and analytics framework and to implement open information technology architectures while working with standards-setting bodies to adopt widely-used common or open standards.

In the shorter term, however, we believe that significant advancements can be made in managing existing road safety and traffic data better, by integrating additional data such as demographic information, crime and impaired driving data, travel behavior data, and weather records. This enables real-time and predictive analytics together with geospatial visualization, to optimize the existing transportation network.

We recommend that the City of Edmonton approach the planning and operations of their transportation system in an integrated way. Data that is collected from the significant instrumentation deployed across the City should be put to better use, and predictive analytics should be extended to broader transportation portfolios.

However, integrated transportation and road safety systems must be based on an enterprise-wide data and analytics framework. Key transport legacy systems must be integrated in order to manage a multi-modal transportation network better.

Stockholm, London, and other global leaders in transportation solutions made a name for themselves by expanding their vision and accelerating their data and analytics strategies. Given the City's significant opportunities ahead, we believe that Edmonton is uniquely positioned to be the global leader in urban traffic safety.

"The City of Edmonton's strategic planning work is setting us on course to become a top-tier city, but enhancing our capacity to collect, analyze and act upon information is critical to our success."

— City Stakeholder

6. Appendix

A. Acknowledgements

Interviewee	Title	Organization
His Worship, Mr. Stephen Mandel	Mayor of Edmonton	City of Edmonton
Lorna Rosen	Chief Financial Officer	City of Edmonton
John Rose	Chief Economist	City of Edmonton, Strategic Management
Craig Walbaum	Director – ITS, Traffic Engineering	City of Edmonton, Transportation Operations
Gord Cebryk	Director – Signals & Street Lighting	City of Edmonton, Transportation Operations
Don Lewycky	Director – Engineering Services	City of Edmonton, Transportation Operations
Rhonda Toohey	Manager, Strategic Transportation Planning	City of Edmonton, Transportation Planning
Stephanie McCabe	Strategic Transportation Planning	City of Edmonton, Transportation Planning
Daniel Mulloy	Corporate Performance Measurement	City of Edmonton, Strategic Management
Don MacDonald	Director – Traffic Control	City of Edmonton, Transportation Operations
Ian Hosler	Walkable Edmonton	City of Edmonton, Community Services
Audra Jones	Director – Transportation Planning	City of Edmonton, Transportation Planning
Ted Hrbien	Superintendent – Traffic Services	Edmonton Police Services
Gerry Shimko	Executive Director	Office of Traffic Safety
Scott McDonald	Senior Speed Management Co-ordinator	Office of Traffic Safety
Bob Boutilier	General Manager, Transportation	City of Edmonton
Dae-Won Kwon, Ph.D	Methods Analyst	Office of Traffic Safety
Laura Thue, Ph.D	Senior Research Co-ordinator	Office of Traffic Safety
Stevanus Tjandra, Ph.D	Senior Traffic Safety Analytical Co-ordinator	Office of Traffic Safety
Shiraz Kanji	Bridge Engineer	City of Edmonton
Patrick Lau	Network	City of Edmonton, Information Technology

Interviewee	Title	Organization
Roy Mesiatowsky	Traffic Application Maintenance	City of Edmonton, Information Technology
Debbie Ritchie	Program Manager – Business Architecture	City of Edmonton, Information Technology
Lihang Ying	Web Systems Analyst	City of Edmonton, Information Technology
Dwayne Budzak	Contract Analyst	City of Edmonton, Information Technology
Terry Owen	Chief of Emergency Systems	City of Edmonton, Fire Rescue
Ken Block	Fire Chief	City of Edmonton, Fire Rescue
George Teply	Director – Neighborhood Revitalization	City of Edmonton, Neighborhood and Community Development
Stephane Labonne	Director – Greater Neighborhoods	City of Edmonton, Neighborhood and Community Development
Bill Horne	Fleet Safety Supervisor	City of Edmonton, Fleet Services
Dennis Simcoe	Fleet Safety – Procurement	City of Edmonton, Fleet Services
Bob Dunford	Director – Roadway Maintenance, RWIS	City of Edmonton, Transportation Operations
Joe Rodgers	Executive Director	Police Commission
Greg Heaton	Director – Corporate Culture	City of Edmonton, Corporate Culture
Brice Stephenson	Branch Manager, Transportation	City of Edmonton, Transportation Operations
Asif Iqbal	Senior Traffic Safety Engineer	Office of Traffic Safety
Don Szarko	Executive Director	Alberta Motor Association
James Donohue	Traffic Applications	City of Edmonton, Information Technology
Darryl DaCosta	Deputy Chief	Edmonton Police Services
Chris Moore	Chief Information Officer	City of Edmonton
Bruce Beecher	IT Client Services Manager, SCC Project Manager	City of Edmonton

Interviewee	Title	Organization
Bill Grodzinski	Chief Superintendent	Highway Safety Division, Ontario Provincial Police
Bella Dumont	Systems Analyst	City of Edmonton, Information Technology
Mack Male	Local Blogger/Activist	Founder, Questionmark Computing Inc.
Stan Teply	Professor Emeritus – Engineering	University of Alberta
Karim El Basyouny, Ph.D	Methods Analyst	Office of Traffic Safety
Tegan Martin-Drysdale	Chair	City of Edmonton, NextGen Committee
Thareesh Kariyawasam	Strategic Transportation Analyst	City of Edmonton, Transportation Operations
Jayme MacDonald	Senior Systems Analyst	City of Edmonton, Information Technology
Perry Richard	Systems Analyst	City of Edmonton, Information Technology
Zuzana Plachy	Project Manager	City of Edmonton, Information Technology
Karen Leibovici	Council Rep on Traffic Safety	Edmonton City Council
Monica Sawchyn	Centre for Advanced Studies IBM/UofA	Center for Advanced Studies
Kim Krushell	Council Rep on Traffic Safety	Edmonton City Council
Shahriyar Khan (for Allan Bolstad)	Community Development Officer	Edmonton Federation of Community Leagues
Don Iveson	Next Gen Council, Transportation	Edmonton City Council
Mark Anielski	Societal Wellness Indices	Economist/Author
Simon Farbrother	City Manager	City of Edmonton, Corporate Leadership Team
Ben Henderson	Chair of TPW	Edmonton City Council
Manijeh Khoee	Corporate Performance Measurement	City of Edmonton, Strategic Management
Rajna Tufegdzic	Senior Automated Enforcement Program Co-ordinator	Office of Traffic Safety
Ashley Casovan	Project Manager, CIOs Office, SCC Project Manager	City of Edmonton

B. Team profile

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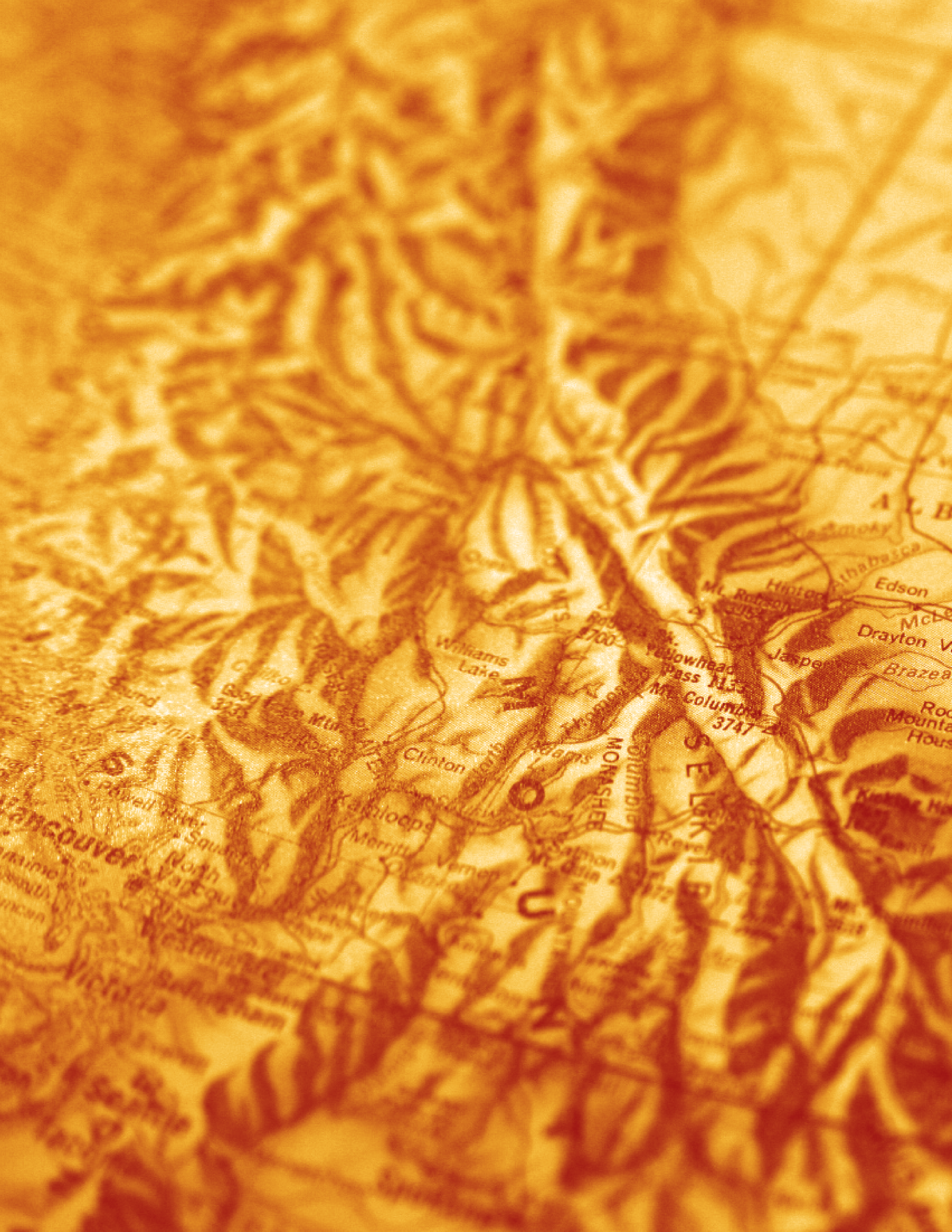
C. References

http://www.transportation.alberta.ca/Content/docType47/Production/AR2010.pdf

http://www.transportation.alberta.ca/Content/docType48/Production/OTS_OpPlan_10-11.pdf

http://www.ccmta.ca/crss-2015/management.php

http://www.edmonton.ca/transportation/RoadsTraffic/traficsafety_lores.pdf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