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The National Routing System: Administrative Data Collection in Real-time

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Abstract

The National Routing System is a multi-jurisdictional effort to improve the collection and validation of birth and death information from provincial vital event registries. Instead of having to wait for batch files to be sent at various points during the year, provinces send individual records as an event is registered. Timeliness is further enhanced by the adoption of data and technical standards. Data users no longer have to deal with multiple data formats and transfer media when compiling data from multiple sources. Similarly, data providers need to perform a once only transformation of their data in order to satisfy multiple clients.

Key Words: Administrative data, Inter-jurisdictional exchanges, Standards, Vital events.

1. Introduction

1.1 Description

Vital Statistics Agencies (VSAs) in provinces and territories are responsible for the registration of birth and death events in Canada. Over time each jurisdiction has developed independent systems for capturing, storing, and disseminating data that was created during the registration process. Similarly, users of the data have a variety of systems in place to process the information received from the provinces and territories. These legacy systems have developed to address specific information needs of both the registries and the users of their data. Many of them pre-date the technological solutions that allow for interoperability. As a result, typical “stovepipe” solutions have been developed to transfer information between organizations with little or no integration. The inefficiencies that result from this approach have been well documented (see Eisner 2005, Linthicum 2000, and O'Carroll 2003, for example). The National Routing System (NRS) is way of overcoming these inefficiencies by standardizing data and technical formats for the efficient transfer of information between multiple organizations.

The NRS is a structure that allows provincial VSAs to electronically exchange information with each other and to distribute information to federal and other provincial departments and agencies. This structure is made up of many components including: data standards, electronic messaging specifications, design and architectural guidelines, privacy assessments, security protocols, project working groups, support and procedures, and exchange agreements.

The NRS is not a single piece of software, central database or repository of data. It utilizes messaging technology that allows data providers to share information in a secure, standard and timely manner. The design of the system gives data providers complete control over the content and destination of the data that they send to information consumers. By standardizing the distribution of information, a single system can accommodate many diverse business needs. This overcomes the inherent inefficiencies that occur when multiple solutions are created to access the same sources of data.

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1.2 Functionality

Two types of functionality were developed for the NRS. First, the *notification* functionality enables VSAs to distribute registration information to various clients as soon as they register an event. The information is distributed in the form of a single message that is related to an individual registration. Messages are sent when the provider is ready to distribute the information and the receivers get the messages as soon as messages are available from the source. This can be in real time or the data provider may choose to build in a delay to accommodate changes to the record that typically are done in the days immediately after the event has been registered.

Organizations that normally process incoming data in batch mode have the option of processing individual records as they arrive. Alternatively they can accumulate the individual records and process them in batch mode. The messaging approach gives them the option of either approach. Furthermore, if they choose the batch processing method, they have control over the timing of the process. Because they accumulate the information they can choose when to process it.

All, or part of the data associated with the registration can be included in the transmission. For example, the Canada Revenue Agency (CRA) receives 20 data elements and Statistics Canada (StatCan) receives 50 data elements from each death registration. CRA requires a smaller subset of data for their program administration purposes, whereas StatCan requires a larger subset for health and demographic indicators and analysis. The amount and type of information that is sent to each organization is governed by the agreement that is put in place between the VSA and the client organization.

The second type of NRS functionality is *validation*. This allows NRS partners to validate information presented to them by their clients. For example, when a client applies for a social insurance number, the issuer (Service Canada) can validate the birth certificate information presented by the client. Service Canada staff key the appropriate information and a query is sent directly to the province of birth for validation against the source database. The validation message that is returned by the province is in the form of flags that indicated the validity of the information.

A by-product of the validation process is that it contributes to improvements in data quality (Menic and Turner, 2006). In effect, the information is being double-keyed by having two independent organizations enter the information. When a flag is returned because of a discrepancy, a follow-up is required to determine whether the error is in the source database, with the information entered in the query, or a true case of fraud.

1.3 Business drivers

Data that are captured during the registration process are a valuable information resource for several provincial and federal organizations. The business requirements of these organizations can be placed into three broad categories: identity management, benefit program administration, and other program efficiencies.

1.3.1 Identity management

A “house of cards” analogy has often been used to describe the importance of vital event information in the context of identity management. For Canadians born in Canada, the birth certificate is considered a foundation document upon which other identity and travel documents are often based. For Canadians born outside of Canada, Citizenship and Immigration Canada provides various foundation documents. In both cases, a persons identity “ends” when they die and the vital statistics agencies across the country are responsible for registering these death events. Once a death has been registered, provinces and territories can perform birth/death linkages to ensure that they do not issue a new birth certificate to someone trying to assume a deceased’s identity.

Timely notification of deaths is an important factor in this process. When a person is born and dies in the same province, the only delay in the process is the timeliness of the internal registration process and the birth/death linkage process. However, when a person is born in one province and dies in another, the speed at which information is shared between organizations is crucial. The NRS provides the structure to enable vital statistics

agencies to quickly obtain out-of-province death notifications in order to perform birth/death linkages. This linkage information ensures that they do not issue another birth certificate for a person who was born in their province but has died in another province.

Up-to-date databases through timely notification are also important for validation purposes. A record containing a death flag alerts the validating organization of a potential fraud. NRS enables organizations that issue secondary identity and travel documents to validate information presented to them on birth certificates. For example, in the NRS Pilot, Passport Canada took information from birth certificates used in passport applications and verified it against the source vital event database in the two VSAs that were members of the pilot. In another example, the Insurance Corporation of British Columbia is validating birth certificate information against the British Columbia Vital Statistics Agency databases when a client applies for an enhanced driver's license. This validation can be done in real time through the NRS while the client waits for the issuing organization to process their request.

1.3.2 Benefit program administration

Both validation and notification play a role in program administration and the NRS can facilitate both. For example, using NRS, as part of the entitlement process departments can validate birth certificate information presented by a person when applying for a government benefit program. Similar to the process for identity management verification, a query containing information from the birth certificate can be sent directly to the province/territory that issued the birth certificate. The registry can then send back a response that verifies whether the information matches the information that they captured during the original birth registration.

Benefit issuing departments can also use the notification portion of NRS to collect information in support of applications for benefits. Name and address collection is part of the normal birth registration process. By adding the opportunity for parents to apply for benefit programs while completing the birth registration, all the information required for entitlement can be sent through NRS to the organization issuing the benefits. This saves the parents from having to go through a separate process to apply for benefits and enables the issuing organization to improve their timeliness in delivering benefits.

Notification also plays a role in ending benefit payments. Timely information about deaths leads to program efficiencies by ceasing payment of benefits. Benefit payments are often automatically deposited in a person's bank account. When the person dies, deposits continue until the estate informs the paying department of the death. This delay can take months. For example, CRA has found that on average they receive death notifications five and a half months after the death occurs. They must then take steps to recover the overpayments. Using timely notifications of death through NRS, this delay has been reduced to ten to fifteen days.

1.3.3 Other program efficiencies

Timely notification of birth and death information can also improve efficiencies in areas other than benefit programs. For example, Statistics Canada is responsible for creating national databases for birth and death information. These databases are used extensively for health and demographic analysis and indicators. Instead of having to wait for batch files to be sent at various points during the year, provinces that have implemented NRS notification can send individual records as soon as an event is registered. This allows programs that rely on the information to integrate the data into their processes quickly. Timeliness is further enhanced by the adoption and application of data and technical standards. These standards reduce the amount of data processing that has to be done before and after data are sent. Data users no longer have to deal with multiple data formats and storage media when compiling data from multiple sources. Similarly, data providers need to perform a once only transformation of their data in order to satisfy the requirements of all NRS data users.

1.4 Design

The NRS design is a significant departure from the way in which administrative data are provided to organizations. Normally administrative data are disseminated in monthly, quarterly or yearly files or "batches". This batch

approach introduces information management challenges to control for duplicate, amended, and missing records. This can be exacerbated when files are re-submitted because of updates to records, particularly when the original records were in different submissions (batches). The design of the NRS eliminates the batch control challenges by sending information at the record level. When an event is registered in the source database, information relating to that record is automatically extracted, transformed, encrypted and sent to the authorized organization(s). The consumers of the information then have a choice to use the information immediately or, accumulate records until their systems are ready to process the information. Once the event is registered, the control over the timing of the processing of the data shifts from source to the destination.

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Real time messaging creates another benefit for data providers. Generally their core business function is not related to the provision of data to other organizations. In the case of vital statistics, they collect information, register events, maintain registries, and provide registration documents to clients. Automating the distribution of information from their registries to other organizations allows them to focus on their core business responsibilities.

Data consumers can take advantage of real time notification by monitoring incoming data. Systemic problems with data submissions can be identified earlier and corrective actions can be put into place. In the traditional batch system, problems would be identified much later in the process once batches have been delivered.

1.5 Architecture

A peer-to-peer service model is used in the NRS. Each data provider organization prepares specific data for distribution for each consumer organization. Information is delivered based on the header in the message envelope created by the provider. In a true centralized broker model each provider would prepare data for distribution only once and the central broker would replicate (or create unique subsets of the data for distribution based on the consumer's authority to receive the data) and distribute the information based on the contents of the message or distribution list.

The peer-to-peer model was utilized for three main reasons:

- The small number of partners makes the distribution of the data manageable.
- The small number of partners also limits the variety of payloads that had to be prepared by the providers. A goal of NRS is to limit the number of payloads by re-using payload definitions where possible.
- The records stay encrypted from sender to receiver and access to the payload is not available to third parties in an unencrypted format. This allows provider organizations to distribute information without making changes to privacy legislation because their records are not exposed to a third party. Only the organizations that had MOUs between them regarding the use of the data are able to view the data.

In contrast, a central model would offer two advantages over the peer-to-peer model.

- In a full NRS production environment a large number of partners will make the management of the distribution of messages more onerous for each provider. A centralized broker would make the task easier because the distribution of messages among all partners could be managed by one source.
- Provider organizations would be able to produce each message only once. The parsing and distribution of the message would be done centrally.

However, governance of, and legislation related to, this central broker remains an issue that needs to be addressed before a central broker is possible. In a central broker model the message from the provider would have to be decrypted, parsed, re-encrypted and distributed by a third party. For some current and/or potential provider

organizations the exposure of their records in this centralized model is not possible under current legislation while others may not be willing to relinquish control over the record in a central broker model.

The two models are not mutually exclusive. A hybrid system where some consumers are endpoints and others are hubs would make the transition to a fully centralized broker easier, although it would not leverage the full advantages of the truly centralized model.

1.6 Security

Multiple levels of security are implemented for NRS message exchanges. They include transport layer SSL encryption, payload encryption, authorization, and authentication. Full payload encryption is maintained during end-to-end transmission from one organization to another. Each organization also performs a Privacy Impact Assessment that reviews the measures put in place to prevent third party access to the data.

2. Challenges

Studies point to governance, organizational, economic and political barriers that must be overcome to streamline the exchange of information between organizations (Landsbergen 2001, Roy 2008). Rarely are the barriers technical. An evaluation of the NRS pilot found that the technical solution was ready to be deployed before the non-technical issues had been resolved (Menic, 2007). This is not a surprising finding – for years software vendors have been developing applications that are meant to be interoperable. These have been deployed within large organizations or between organizations with common business requirements, e.g. banking services. NRS faces unique challenges because the business requirements of many of the organizations using the information are so diverse.

2.1 Governance

Diverse business requirements make it difficult to create a governance model that represents the interests all organizations equally. Each province/territory has the authority to collect information during their registration process within their jurisdiction. Federal and provincial/territorial departments and agencies obtain the information from the registries for different purposes that can vary from identity management, program administration and health and demographic analysis. No one organization has the legal or legislative authority to collect or distribute all of the information related to vital events (birth and death) for all provinces and territories. As a result, there is no obvious choice for an organization to govern the exchange of vital event information.

A governance structure is needed to deal with the competing priorities can arise from varied business requirements. For example, adding all provincial/territorial registries to NRS is a priority for those organizations requiring vital event information for national databases. For other organizations, adding the largest registries is a priority because the cost of adding some of the smaller registries outweighs the program benefits that would accrue to them by doing so.

The NRS adopted a collaborative governance approach. Each organization is autonomous and enters into its own agreements with other NRS organizations. No organization is obliged to implement all aspects of NRS either from a data or functionality perspective. For example, some organizations may choose to implement only the notification portion of NRS and transmit only selected data elements. The decisions made by an organization affect only its trading partners and itself. However, each organization has incentives to collaborate. NRS reduces the number of solutions (e.g. data definitions, software applications) it has to maintain with other organizations in order to receive and/or send data. NRS also enables organizations to tap into expertise of other organizations using the same approach and reduces overall costs by leveraging previous investments in the common solution.

Each member organization is represented in the project level management group and is invited to participate in the various working groups. In addition, a formal change management system is in place that requires agreement by all NRS partners before significant changes are implemented. The challenge facing NRS is to maintain the

collaborative nature of the project as the numbers of partners increase and new demands are made on the functionality of the system.

2.2 Organizational priorities

Each organization builds their priorities around a specific mandate related to their business requirements. Vital statistics registries, for example, collect information, register events and issue registration certificates when necessary. Providing information to other organizations is a secondary priority. From a user perspective, priorities differ. Organizations that require vital statistics information to efficiently deliver administrative programs are not interested in the health-related data found on the vital records that are so important to organizations involved in health analysis. Activities that require participation by all partners (e.g. testing) can be challenging to organize because of competing priorities related to the core business function in each organization. This challenge is further exacerbated by the time zone differences that narrow opportunities even further.

Organizations are often under pressure to deliver programs quickly. In a collaborative environment such as the NRS, changes to accommodate new functionality could be slow to develop because agreement is required by all partners. An organization has a better chance of delivering solutions quickly by developing specific solutions with individual partners because they do not have to wait for consensus from a larger group. Unfortunately, this leads back to the stovepipe solutions that the NRS is trying to avoid. The demands to deliver programs quickly are a disincentive for departments to take the "big picture" into consideration and take the time necessary to participate in a collaborative environment. In the short term the costs to the individual department are easily justified but the duplication of effort – government wide – is costly.

Among the data providers there is a substantial variation in mandate, resources, and organizational complexity. Many of these differences are a result of the size of the jurisdiction. Ontario registers over 220,000 births and deaths each year while each of the territories register approximately 500. Differences also arise from the reporting relationships within governing ministries that affect the direction of each organization. These factors all influence each organizations ability and willingness to join NRS.

2.3 Technology standards

NRS partners are not required to use any specific software applications but they are required to use messaging software that complies with a particular Open Standards specification (ebXML). This approach provides latitude for each partner to choose software that best fits their technological environment while at the same time providing a common basis for interoperability of the solutions that each has chosen.

NRS partners have integrated several commercial of-the-shelf (COTS) products, but not without some effort. Although COTS messaging system vendors met ISO specifications, the implementation of those specifications differed and interoperability issues arose between vendors' products. To alleviate some of the interoperability challenges, the NRS project management office (PMO) recommended that new partners choose software that meets independent third party certification for interoperability. Furthermore, the PMO coordinates partners' efforts with a full suite of interoperability tests.

2.4 Data standards

National Statistical Offices are often in a unique position with respect to negotiating common data exchange standards because they have had long-term relationships with data providers and with international standardization bodies. In Canada, where the provinces and territories have the legislative mandate for certain sectors (e.g. health, education, justice) within the federal framework, it is often the case that administrative systems develop independently in each jurisdiction and there may be political resistance to harmonization. Statistics Canada, because of its political independence, plays a key role in resolving data standardization issues at a national level even though the major benefits accrue to other federal agencies.

2.5 Funding

A substantial cost is incurred by the data providers to develop and implement NRS functionality. Although they realize some benefits in the form of per record/per query reimbursement and in operational efficiencies, in the short term their costs outweigh their benefits. As a result, the vital statistics agencies that provide information require assistance in offsetting their costs.

Most of the benefits are realized by the users of the data because timely, standardized information has a positive impact on their operational processes and costs. However, benefits that accrue to any one organization are less than the costs of implementing the full solution, making a cost-benefit argument difficult for an individual department. On the other hand, the benefits to all organizations combined would make the financial case for funding.

The solution to funding NRS is like the governance challenge – a collaborative approach. Development and maintenance costs are covered by various NRS partners. However, funding decisions are made on a year-to-year basis and a long term funding strategy is required to ensure stability. The funding strategy should be closely tied to the governance model because of the relationships between them.

3. Achievements

Despite the substantial challenges, particularly on the funding and governance issues, the NRS project is making progress. To date, four provincial vital statistics agencies, two provincial driver's license issuing organizations and three federal departments/agencies are using the NRS to exchange, distribute and validate vital statistics information. These organizations are demonstrating that a single solution can be implemented to service a number of diverse requirements. Statistics Canada is using the NRS to collect data in a timely manner to be used in health and demographic research. Canada Revenue Agency and Service Canada are using NRS to help administer benefit programs through timely notification and through validation of birth information. And finally, Manitoba Public Insurance and the Insurance Corporation of British Columbia are developing the NRS functionality to validate birth certificate information for identity management purposes in relation to Enhanced Drivers' Licenses. A number of other organizations are considering or developing NRS capabilities as the advantages of the system become known and funding becomes available.

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