REPORT ON AUSTRALIAN AND INTERNATIONAL PRACTICES FOR THE EXCHANGE OF COMMUNITY BASED ASSET DATA

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A Cooperative Research Centre for Integrated Engineering Asset Management (CIEAM) project has been established by the Queensland University of Technology, and the University of South Australia to develop an integrated framework for community based asset management and to establish technology environments for the interoperable exchange and management of asset data. Community assets can be defined broadly as people, places, organisations and infrastructure that are used to achieve a community's vision and goals. The focus of this project is the infrastructure assets held in trust by local governments for the benefit of the community. Community infrastructure assets are used to deliver a wide variety of community services. This paper provides a review of the different practices undertaken around the world for the exchange of community based asset data.

Key Words: Community Assets, Data Exchange

1. BACKGROUND ON COMMUNITY ASSETS DATA EXCHANGE

Community assets can be defined broadly as people, places, organisations and infrastructure that are used to achieve a community's vision and goals. This project will focus on community based infrastructure which is held in trust by local governments to deliver local services.

2. EVOLUTION OF COMMUNITY BASED ASSET DATA EXCHANGE

Exchange of community based asset data (in a digital form) is a relatively new concept. Traditionally information has only been available through specific requests to target organisations. This is a slow, cumbersome and expensive process because of the different technologies used (digital and hardcopy), terminologies, commercial proprietary systems and data formats. It is still common practice to exchange community based asset data prepared in digitally, in hard copy format. The recipient organisation then reconverts this data back into a digital format to suit their system requirements. One of the biggest drivers of information exchange to date has been contractors needing to know where conflicting services are located within road reserves.

3. EXCHANGE MODELS

Three models have evolved to facilitate the exchange of community based asset data information between agencies:

- A common data approach;
- A common system approach; and
- An information interoperability approach across different systems.

Most current exchange models are asset class specific (e.g. roads).

3.1 Common Data Model

Common data models utilise common data across different data sets. Normally the data sets are collected for a different purpose with a "best fit" approach adopted. This approach is useful to obtain an initial overview and it avoids the need to design special data collection programs. `However, the accuracy of the final result will be impacted by the requirement to accept that data may have been collected with different definitions and accuracy levels. The major advantage of this approach is the elimination of the need for specific data collection. The major disadvantage is that the final result may be of limited value and of limited extent because of the lack of alignment of data sets.

Example - Australian Local Government Association National Local Roads Database System (Reference 1)

The Australian Local Government Association (ALGA) has developed the National Local Roads Database System (NLRDS). The system utilises existing data collected annually by State Grants Commissions and calculates the following performance measures:

1. Sealing of gravel roads (based on length of unsealed roads)
2. State of the asset (current replacement costs and written down value for roads and bridges)
3. Expenditure on roads and bridges(maintenance, capital renewal, capital upgrade, and capital expansion expenditure)
4. Expenditure on roads and bridges per km for sealed roads(expenditure on sealed roads divided by sealed road length)
5. Expenditure on roads and bridges per km for unsealed roads(expenditure on unsealed roads divided by sealed road length)
6. Road asset consumption(current replacement cost and depreciation for roads and bridges)
7. Road asset sustainability(maintenance, capital renewal expenditure and depreciation expense for roads and bridges)
8. Road safety(road fatalities per council area)

Accuracy of the NLRDS is limited to the accuracy of data provided by councils to the Grants Commissions. Completeness of the dataset is also limited by the contribution of councils to the Grants Commissions surveys and there are variations in data definitions.

3.2 Common System Model

A common system approach has been the most widely utilised system over the last twenty years. If all users use the same system, the same data definitions and the same collection methodologies, data sets can be easily aggregated to any level required. A common system is usually only feasible in smaller uniform markets where individual organisations have not developed or purchased individual systems. They are also quite common where there is a central funding agency. Advantages of common systems include economy of scale and the ease of data aggregation. Disadvantages include a reduction in innovation and the requirement to conform to a "One size fits all" approach.

Example – Western Australia "Roman" Asset Management System (Reference 2)

Western Australia has a long history of State and local governments working together in road asset management. In the 1980's the ROMAN road asset management system was developed in a mainframe environment as a result of the collaboration of a number of Local government Engineers from eastern Perth metropolitan councils and the then Main Roads Department now Main Roads Western Australia (MRWA). Over time it has evolved from the centralised mainframe to a localised PC based program running since 1998 in a Windows operating environment.

Councils submit data from the Roman system on a regular, annual basis to MRWA which uses the information to maintain maps and inventories for the entire road network. Data from the Roman system is used by the Western Australian Local Government Grants Commission to distribute the road grant portion of Australian government grants to local governments.

Roman is jointly owned by MRWA and the Institute of Public Works Engineers Australia (WA). As a desktop road asset management tool it provides the following features:

- A detailed inventory of roads, paths and point items together with their age and current condition rating;
- A valuation package that allows Councils to comply with Australian Accounting standard requirements; and
- An indicative works program feature.

All Western Australian local governments are provided with the inventory module software free of charge and they pay an annual maintenance fee to access the other functions. This system has served Western Australian local governments very well over many years. Western Australia is the only Australian state which has been able to offer a comprehensive picture of the extent and condition of its road network.

Example - New Zealand "RAMM" Asset Management System (Reference 3)

The Road Assessment and Maintenance Management System (RAMM) was developed in the 1980's and is the main road asset management system used in New Zealand. The use of RAMM is mandatory to obtain financial assistance from Land Transport New Zealand. RAMM contains all roads in the network and includes detailed information on carriageway widths, surfacing types and ages, pavement composition, traffic volumes and road condition data. It also contains information on structures such as culverts, footpaths, bridges and signs. RAMM is updated annually with changes made to the network. RAMM also incorporates a treatment selection programme which utilises condition and road inventory data to identify road sections which should be considered for rehabilitation or reseals. The RAMM system has helped to establish New Zealand's reputation as a leader in road asset management. The common system approach has enabled New Zealand to provide a consistent national picture of the extent and state of the road network.

Example – Norwegian Road Data Base (Reference4)

The Norwegian Road Data Base (NRDB) is a new data base containing road and traffic data. Users are provided access to the data based on their specific needs. The NRDB has been developed by the Public Roads Administration primarily for its own use, but is also available to external users including public authorities, municipalities and organisations and the general public. The NRDB consists of inventory, traffic and condition data together with photographs at 20 metre intervals.

Example –ADAC (Reference 5)

The ADAC (Asset Design & As Constructed) product is developed and maintained by a consortium of Local Government agencies in Queensland, Australia in conjunction with the Institute of Public Works Engineering Australia. The process is used to facilitate the collection and lodgement of detailed information on contributed civil infrastructure and associated assets provided by the private sector to local governments.

The consortium has developed a standard which defines:

- the information required for each asset type;
- the terminology to describe this information; and
- allowable values

From this, a program has been developed for the commonly used AutoCAD engineering software, to facilitate the collection of this information, and define the format in which the data is stored. The product is offered free of charge by participating ADAC Member Councils to their private sector partners involved in the property development industry to ensure a uniform approach is adopted. The product comprises a suite of AutoCAD drawing routines, relevant asset standards, and user documentation.

In addition to the AutoCAD-based ADAC tool currently supplied free to customers, a v3.0 XML schema has been produced and offered free for use. This is intended to allow software vendors and industry companies to develop their own tools that are compliant with the current ADAC XML definition.

The development of the XML schema is designed to facilitate the ADAC long-term product development strategy. It is expected that over time, high quality industry standard products will provide and support "in-built" functionality capable of both capturing ADAC asset data and producing compliant file outputs.

A number of benefits have been recognised with the adoption of the ADAC process:

- It allows local government to automate the data validation and upload process, speeding up the plan sealing process;
- It greatly standardises the information required by different local governments, easing the "flavours" required to be produced by industry;
- It improves the management of assets by local government, reducing community costs;
- It allows for the "electronic validation" of asset information against a defined rules base;
- It aids the provision of accurate data back to industry for subsequent works;
- It provides a proven business process for future development, allowing investigation of more efficiencies and the potential use of developing technologies; and
- Efficiencies can potentially be gained by updating ADAC design plans with As-constructed information.

The ADAC process is currently only for uploading to local government GIS and asset systems and facilitates the upload of cadastre, water, sewerage, roads and drainage information. ADAC is the only example found in the research that covered multiple asset classes.

3.2 Interoperability Model (Common Standard Model)

The term ‘interoperability’ means different things to different segments of the information technology world. To a network operator, it can mean the ability to inter-operate with other networks and provide seamless services to users; to a content provider or service provider, it can mean the ability to run an application or service on any suitable platform and to the consumer, it can mean the ability to have access to information or services without needing to have specific hardware or software. In summary, interoperability describes the capability of two or more hardware devices or two or more software routines to work together.

Technical interoperability can be achieved through the use of Open Source and/or Open Standards. Open Source refers to a particular kind of licensing arrangement which allows software developers to build on existing source code free of charge. Open Standards on the other hand refers to a technical framework (rules and specifications) which collectively describes the design or operating characteristics of a program or device and is published and made freely available to the technical community.

Interoperability or common standard models have the advantage of not requiring all users to operate the same system which promotes competition and innovation in the industry. A disadvantage is that they require a strong coordinating authority to drive the development and acceptance of common standards and common definitions.

Example – European Interoperability Framework (Reference 6)

The European Interoperability Framework (EIF) was first published as a draft in 2004. The EIF defines a set of standards and guidelines which describes the way in which organisations should interact with each other. The three aspects of interoperability considered in the EIF include:

- Technical – linking up computer systems by agreeing on standards for presenting, collecting, exchanging, processing and transporting data;
- Semantic – ensuring that transported data shares the same meaning for link-up systems; and
- Organisational- organising business process and internal organisation structures for better exchange of data.

The EIF promotes Open Standards as the preferred approach for the achievement of interoperability. This is because Open Standards allows greater accountability and provides protection of intellectual property rights. The EIF sees the greatest barriers to achieving interoperability as not being technical but in the areas of semantic and organisational interoperability. Technical interoperability has been achieved in a number of areas by the information technology Industry. Examples include GSM, Ethernet, TCP/IP, SMTP, XML and web services.

Example - IFC Building Model (Reference 7)

The building industry has embraced the issue of interoperability through the development of model based applications. Most of the focus has been on the IFC (Industry Foundation Classes) developed by the IAI (International Alliance for Interoperability) to facilitate interoperability in the building industry. The IAI is a global consortium of commercial companies and research organisations founded in 1995 (now 14 chapters in 19 countries and 650 member companies funding its development). Technical information about the IFC building model is documented in detail and is readily available to software developers. The IFC is an object-based building data model that is non-proprietary. The IFC model is intended to support interoperability across the individual, discipline-specific areas (architecture, building and engineering) that are used to design, construct, and operate buildings by capturing information about all aspects of a building throughout its lifecycle. It was specifically developed as a means to exchange model-based data between model-based applications in the AEC (Architecture, Engineering and Construction) and FM (Facility Management) industries, and is now supported by most of the major CAD vendors as well as by many downstream analysis applications.

The IFC model represents not just tangible building components such as walls, doors, beams. Ceilings, furniture etc., but also more abstract concepts such as schedules, activities, spaces, organisation, construction, maintenance and operating costs etc. in the form of entities. All entities can have a number of properties such as name, geometry, materials finishes etc.

The actual development effort of the IFC model is undertaken by the Model Support Group of the IAI. The development work has been underway for several years, with regular releases of new versions. The first version of the IFC, version 1.0, was released in 1997. The latest version was released in 2003, IFC 2X2 and is the seventh release. Each subsequent version adds capabilities to represent more entities and more relationships related to a building's lifecycle.

Because the IFC is an open data exchange format that captures building information, it can be used by the commercial building-model based applications to exchange data with each other. This requires the application to be "IFC-compliant" which means that it is capable of importing and exporting IFC files. Applications get the IFC-compliant tag by going through a certification process. The IFC model specification is posted publically and accessible to anyone, so developers can work with it and build the necessary IFC import and export capabilities into their applications. The IFC is the most highly developed community based asset data exchange based on the level of support it has received and the level of development undertaken. It has become the benchmark for interoperable based models.

Example-Queensland Road Alliance (Reference 8)

The Queensland Road Alliance (Queensland Department of Main Roads and Local Governments) is a voluntary alliance which manages the lower order state roads and the higher order local government roads. The road network managed is termed the Local Roads of Regional Significance (LRRS). The Roads Alliance operates through 18 Regional Road Groups (RRG's). The key objectives of the Alliance are to:

Maximise economic development and benefits through better funding allocations;

- Achieve maximum efficiencies for state and local governments through a combined approach to road network planning and project scheduling; and
- Invest in improved road management and delivery capability through increased training, advanced technology and systems transfer.

One of the major focus areas of the Alliance has been on improving asset management and in particular asset management data for Queensland roads. The Queensland approach has been to not to mandate the use of a common system (such as ROMAN in Western Australia) but to establish standard data definitions and transfer specifications to facilitate the exchange of data between systems and into a central repository called the Road Alliance Hub. All asset systems used in Queensland are encouraged to be ability to import and export data in the specified formats.

The Road Alliance is following a strategic asset management approach with an exchange of data throughout the strategic asset cycle. The Road Alliance has developed data sets which measure the current extent and condition of the road network, the service targets for the road network and the forward program of works.

The Alliance Framework Methodology consists of:

- A common road classification system;
- The same type of data collected for roads and structures – minimum common dataset;
- The same methodology for condition evaluation for roads (sealed and unsealed) and structures;
- Standardised data transfer specifications and common reporting templates;
- Systematic procedures for inspection scope and frequency; and
- Records of inspection and storage of collected data.

Example-German Road Data Management [Reference 9)

Road data is stored and administered in Germany in State based databases. Each German State independently decides on the structure of data and on the platform for the database that it uses. To collate this data at a Federal level, the German data exchange standard OKSTRA was developed (Figure 1.0). Data from each system is exported in OKSTRA format and imported into the SIBView5 system for reporting, visualisation and calculation of statistics. SIBView5 controls and imports the necessary road asset data into a national pavement management system. Data in SIBView5-DB is not editable and is not meant to be an alternative to the State systems.

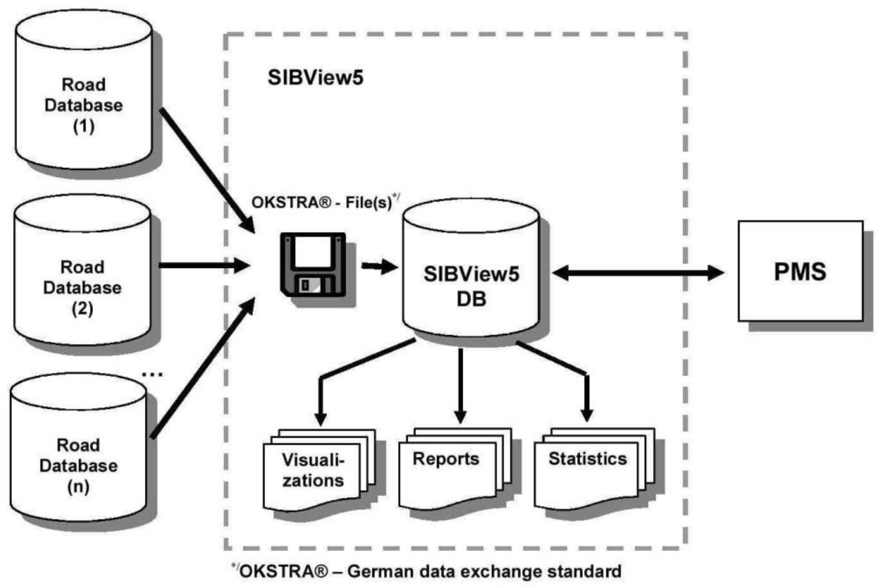

Figure 1 – German Data Exchange Standard

Reprinted from: Heller; S, Consolidating Trust in Road Asset Management by Means of a Dynamic

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Example –Municipal DataWorks (Reference 10)

Municipal DataWorks (MDW) is a web-based data storage repository in which municipalities enter data on the extent and condition of their roads and bridges. Municipal DataWorks is a membership service of the Ontario Good Roads Association (OGRA). Currently 277 municipalities and over 35 service providers have signed up to use MDW. OGRA understands the importance of knowing the extent and condition of the municipal road network in Ontario.

OGRA is developing three asset management tools.

The three tools are:

- Bridge Inspections;
- Capital Investment Plan; and
- Asset Valuation (for PSAB purposes

The Municipal DataWorks database is based on an open data standard (MIDS). MIDS includes water and sewer data standards as well, thus making the database expandable to include these assets in future.

These four components (inventory plus three tools) combine to form the backbone of OGRA's infrastructure asset data management system.

The inventory module forms the foundation of the system. The inventory module provides each municipality with the following capabilities:

- Look-up and view assets based on the Municipal Infrastructure Data Standard (MIDS) attributes ;
- Add/edit assets and related details;
- Enter, store and maintain condition data and other management criteria to be used for Capital Planning; and
- Generate a variety of detail, summary and aggregate reports.

OGRA is able to prepare reports based on rolled-up (aggregate) data.

The Infrastructure Data Standard (MIDS) is a set of definitions that are organized according to a series of business rules that specifies how to store and manage information about networked infrastructure. The infrastructure currently included in MIDS is roads, water distribution, wastewater and storm collection, rail, trails and structures. MIDS is essentially a specification for infrastructure owners that facilitate the collection, management and analysis of data.

Municipalities and other infrastructure owners use the standard as a tool to design and implement their infrastructure database. MIDS promotes the strategic management of information and supports the sharing of data amongst multiple business applications while further enabling the exchange of that same information with service delivery partners, adjoining infrastructure owners and other stakeholders.

The MIDS standard has the following characteristics:

- Integrated data: data that is organized by topics (e.g. all data about bridges) rather than by use or application (e.g. maintenance data about bridges, financial data about bridges, etc.) There are many advantages to integrated data in modern business and service delivery;
- Open data standard: accessible to anyone on reasonable terms;
- Non-proprietary data standard; and
- Technology-independent data standard.

4. CONCLUSIONS

Exchange of community based asset data (in a digital form) is a relatively new concept. Three models have evolved to facilitate the exchange of community based asset data information between agencies: a minimum common data approach, a common system approach and an information interoperability approach.

The common data approach is limited by the need to find "common data" in data sets from different sources. The lack of standardisation of data definitions, data measurement and data collection methodologies significantly affects the quality of the output. The resultant data provides only limited benefits but this approach can be justified as an interim measure while more robust systems are under development.

The common system approach is the oldest electronic method in use with some common systems evolving over twenty or more years. A common system by definition overcomes data exchange issues. However, the "one size fits all" approach limits innovation and these systems often struggle to address the needs of organisations with differing requirements and resource levels. Modern common systems address the different needs issue by offering "core" and "non - core" modules. The use of web based technologies can also assist with local resource restrictions.

The interoperability approach is currently receiving the most attention and development around the world. It combines the benefits of the common system approach with the achievement of standardised outputs but it allows greater flexibility and innovation by allowing the use of different foundation systems. The Open Standards approach is preferred to the Open Source approach because of greater accountability and the ability to protect intellectual property. The greatest barriers to the achievement of interoperability are not technical but are in the agreement of common data dictionaries and the restructuring of organisations to facilitate the process.

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