- **Final Paper** -

IMPLEMENTING AN ASSETWISE APPROACH TO ROAD ASSET MANAGEMENT

Theme: **Innovation in Infrastructure Construction and Maintenance**

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Abstract

Government agencies and commercial organisations face increasing challenges to maintain roads and their assets to high service levels whilst being able to demonstrate proper allocation and use of all resources (financial, personnel, materials and equipment). These resources are often highly constrained or subject to increasing financial constraints. This paper explores the use of a new paradigm which will take the benefits of an integrated road asset management system and extend this to be part of the overall life cycle of asset management.

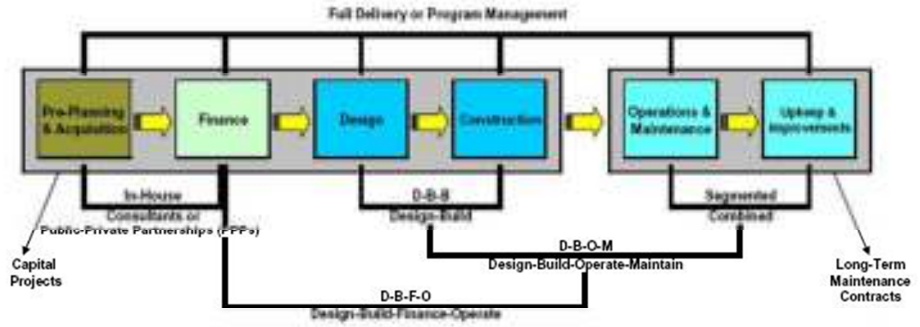
The Design, Build, Operate and Maintain life cycle describes the process of asset management. However, information systems have traditionally focused on parts of this life cycle resulting in silo systems or at best integrated solutions to manage part of the process (e.g. operate and maintain). This results in inefficiencies and increased costs as asset data and information derived during the initial phases (Design, Build) is not available later without expensive data collection or data verification processes in order to populate an integrated asset management system. Integrating the complete cycle will enable organisations to pass data from as-builts into the operate and maintain process and to make updated asset data available to feed back into the design process to assist with future works e.g. remedial schemes. Organisations will then be able to operate in an Assetwise manner enabling them to leverage the synergies that this will provide.

IMPLEMENTING AN ASSETWISE APPROACH TO ROAD ASSET MANAGEMENT

Chapter 1 – Introduction

Roads are a vital part of a nation's Transport Infrastructure and they are critical to the economic well-being of a country. For National, State or Local government agencies involved in managing assets the road network is often the most highly valued. However, economic circumstances are resulting in a drive for greater efficiencies and the challenge to maintain or improve services whilst being subject to constraints such as funding cuts. To maximise improvements it is no longer sufficient to assess the processes that affect part of an asset's life cycle rather we need to consider the process as a whole from design, build, operate, maintain and eventual decommissioning or, for roads, renewal and re-design to lengthen their lives.

Asset processes are often described in terms of the contractual basis upon which they are delivered. There are multiple types of contractual arrangements such as Design Build with a Warranty, Design Build Operate Maintain and Design Build Finance Operate. Figure 1 from Pakkala (1) illustrates different types of project delivery approaches that combine various phases of the project life cycle.



Source: Pekka Pakkala. *Innovative Project Delivery Methods for Infrastructure - An International Perspective*. Finnish Road Enterprise, Helsinki, 2002, p. 32.

Figure 1 Full Delivery or Program Management.

This description of the process from a contractual perspective mirrors in broad terms the sequence of activities as well. The above process puts an implicit boundary between the activities leading up to the construction and the subsequent operate and maintain and upkeep and improvement activities. This is because there are different contractual responsibilities involved as the process progresses with different organisations providing focused and often specialised services. Each is motivated to improve processing within its sphere of influence which leads, for example, to the development of project collaboration tools during the design process. However, once this process is complete the asset becomes the responsibility for another organisation which must then collect the data it requires.

Unfortunately, this leads to the boundary illustrated in Figure 1 above between Construction and Operate and Maintain becoming a physical one from an asset information perspective because the focus is on parts of the process whereas the key data element is the asset flowing through it. As Halawy et al (2) commented in their paper:

"…most municipalities lack a formal and documented hand-over strategy for design, construction, and rehabilitation information at the end of projects (e.g. as-built drawings and specifications), and they lack a way for integrating this information back into their databases to reflect the as-built nature of their assets."

What is the cost of this issue ? The 2004 NIST report (3) which examined the costs in the U.S. Capital Facilities industry arising from:-

- Avoidance (e.g. redundant CAD / CAE systems, maintaining paper backups)
- Mitigation – interoperability issues (e.g. the cost of re-entering data into multiple systems)
- Delay – that arise from interoperability issues e.g. delays in project completion

NIST estimated that US$15.8billion of interoperability costs were "quantified for the capital facilities industry in 2002. Of these costs, two-thirds are borne by owners and operators, which incur most of these costs during ongoing facility operation and maintenance (O&M)." This figure was felt to be conservative.

The ARC Advisory Group in their report (4) extrapolated the findings in the NIST report and estimated that the combined additional CAPEX and OPEX costs "represented a loss of 4.2% of installed costs. If an owner / operator used installed cost as the basis for evaluating financial performance the additional OPEX costs suggested by this study would represent an ongoing penalty of 2.8% in Return On Assets".

Bridging this gap and focusing on the asset will result in efficiency improvements and better data management offering the industry cost savings – an Assetwise approach.

Chapter 2 – Current Approach

The current approach involves a number of discrete processes operating within parts of the life cycle. Some of these processes maybe integrated within their particular areas of specialism in order to leverage benefits to those organisations involved in those specific processes.

For example, design software will be used and on large projects a project collaboration tool will be deployed to support to support the use of multiple teams in different organisations and locations. This integration helps facilitate the design process as it helps to reduce errors and duplicated work.

Maintenance of roads and their assets is a highly sophisticated activity. The specialist nature of these road assets means that specialist systems are required to manage them. General Enterprise Resource Planning (ERP) or Enterprise Asset Management (EAM) systems by their nature will not have niche engineering product functionality such as network intelligence (e.g. multiple linear referencing systems); lack the ability to handle high volumes

of condition data from pavement condition surveys and lack the algorithms required to analyse this data to derive pavement condition indices nor do they have the ability to calculate and generate Bridge Condition Indices. In many agencies there may still be a departmental or silo based approach to managing these assets. This leads to individual applications being used within each department often with data redundancy being incurred as a result.

However, there has been a move towards adopting solutions which provide the specialism each particular asset requires but which at the same time are integrated to provide the organisation with a holistic view of the assets it is responsible for as well as a departmental focus. This integration has seen agencies derive benefits in the Operate and Maintain part of the life cycle of an asset as departments are able to utilise specialist applications within an integrated environment. Individual departments are able to manage their operational activities and budgets as they need to but this data and information can be managed and reviewed by executive management who will have the capability to track and monitor activities using, for example, an Executive Information Manager or Dashboard portal.

This level of integration can also be mirrored during the design processes. Design tools can be integrated and work alongside project collaboration software, document and configuration management software and workflow process software.

However, there are still breaks during the process – especially between the design and build processes and the subsequent transition to operate and maintain. Effectively there are islands of integration. The data created in these key areas is often isolated and is not passed through. This means that, for example, as-built data is often not made available to the engineers who will be maintaining the as-built assets. Typically a separate data collection exercise is undertaken to collect data which is be maintained within an Asset Management system.

Chapter 3 – Moving to an Assetwise Approach

To help resolve the issues and inefficiencies identified above we need to take the best practises currently available in the disparate processes and enable them to work together. Technology advances and the use of cloud technology now provide the technical capability to link these disparate processes across different organisations in a way not previously achievable.

Some companies are already moving to promote this capability. Bentley Systems, for example, has traditionally operated in the project management, design and generation of as built data. However, in order to recognise the importance to customers of managing and maintaining the built infrastructure specialist software has been acquired from Exor Corporation and Enterprise Informatics to enable Bentley to offer a suite of solutions enabling an asset to be managed through initial conceptualisation, design, build, operate, maintain and eventual de-commissioning or subsequent re-design and updating to extend the asset's life.

Adopting such an approach leads to a more holistic and complete approach with respect to the assets – an Assetwise approach. To illustrate this further Figure 2 shows how the Design and Project Management processes are combined with the Infrastructure Asset Management

processes to deliver a portfolio of software applications addressing the entire lifecycle of the asset. The ARC Advisory Group (4) describe separate Design and Project processes as being part of Project Information Management (PIM) and the Asset Management processes as being Asset Information Management (AIM) - Asset Lifecycle Information Management (ALIM) brings these processes together. Assetwise capitalises on this concept and provides a practical way to implement it.

Figure 2: An Assetwise Approach

For the industry to adopt this process in practise open standards are required to increase the ability for data to flow through the cycles identified in Figure 2 where a heterogeneous mix of software solutions are in use.

Once this integration is in place the users will not only be able to avoid the issues and costs of data redundancy etc but they will also be able to access information in a new and improved way as the data elements can be linked.

For example, we're able to create a 'web' of connected data elements which span the complete lifecycle of the assets as illustrated below. We're much better able to take a document and branch out to any other number of related data elements e.g. which physical item (asset) is this document associated with ? Which people in the organisation are associated with it ? What project / design information is associated with it ? We can support a 'document centric' view of our information.

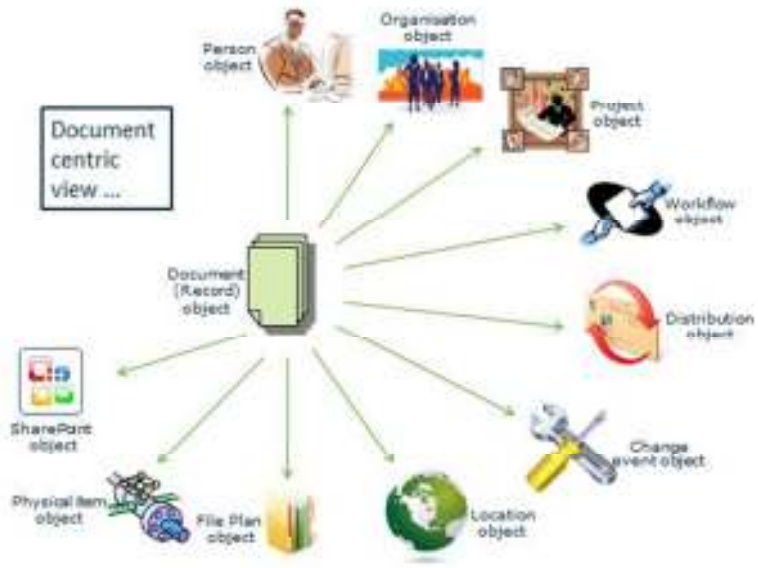


Figure 3 Document-Centric View

Alternatively a user will have a number of different information items they are associated with. We can, therefore, access the data elements associated with an individual person as illustrated below in Figure 4:

Figure 4 Person-Centric View

Finally we can also view all the items associated with a physical asset:

Figure 5 Asset / Product-Centric View

In our web of information described above it is possible to link from any individual item to any other irrespective of which part of the process has created or is maintaining that data element (subject to any access or security restrictions). As can be seen we now have a truly Assetwise view of our information universe rather than discrete silos. Our Assetwise universe enables us to integrate all the processes involved in an asset's life span and provide flexibility in terms of how this information is accessed.

Chapter 4 – The Future

The industry now recognises the challenges that it faces and the investment required in solutions to help it work efficiently and effectively. Commercial and budgetary pressures are helping to drive innovation from a business process and a technology perspective. The technology drive towards increasingly open systems and sharing data will enable us to develop the Assetwise approach further.

For example, 3D city modelling and semantic cities are relatively new concepts and at the early stages in terms of evolution. We can expect these to radically change the way solutions are used. For example, 3D virtual landscapes have value throughout the entire asset life cycle. A 3D city model could be used not only for assessing the impacts of new buildings, transport links etc on an environment but also act as the conduit for subsequent asset management of the data the models represent.

References

1. Innovative Project Delivery Methods for Infrastructure – An International Perspective: Pakkala, Finish Road Enterprise, 2002, page 32
2. Standard data models for interoperability of municipal infrastructure asset management systems: Halfawy, Vanier, Froese, 2006 NRC page 1461
3. Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry, National Institute of Standards and Technology, NIST GCR-04-867, August 2004 page 7
4. Information Management Strategies for Asset Lifecycle Management: ARC Advisory Group, Snitkin and Mick January 2010, pages 4 – 5, 19