"A Comparative Analysis on Data Collection for Assisting Investment Decision Techniques of Asset Management"

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Abstract – Transportation agencies engage in extensive data collection activities in order to support their decision processes at various levels. However, not all the data collected supply transportation officials with useful information for efficient and effective decision-making.

This research presents research aimed at formally identifying links between data collection and the supported decision processes. The research objective identifies existing relationships between Asset Management data collection and the decision processes to be supported by them, particularly in the project selection level. It also proposes a framework for effective and efficient data collection. The motivation of the project was to help transportation agencies optimize their data collection processes and cut down data collection and management costs.

Asset Management is a strategic approach to the optimal allocation of resources for the management, operation, maintenance, and preservation of transportation infrastructure (FHWA 1999). The concept of Asset Management combines engineering and economic principles with sound business practices to support decisionmaking at the strategic, network, and project levels.

One of the key aspects of the development of Asset Management is data collection. The way in which transportation agencies collect, store, and analyze data has evolved along with advances in technology, such as mobile computing, advanced sensors, distributed databases, and spatial technologies.

These technologies have enabled data collection and integration procedures necessary to support the comprehensive analyses and evaluation processes needed for Asset Management. However, in many cases, the data collection activities have not been designed specifically to support the decision processes inherent in Asset Management. As a result, the use of the aforementioned technologies has led agencies to collect very large amounts of data and create vast databases that have not always been useful or necessary for supporting decision making processes.

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INTRODUCTION

Engineering Asset Management (or Asset Management, in short), as technology, process or system, lias also benefited by the exercise of research. The last ten years have tremendous growth in this area of research. A number of research articles dealing with engineering asset management were published in various journals and conference
proceedings. A deliberation 011 the publications reveals that a major portion within asset management related studies is covered by various investigations into technologies like Reliability, Process modelling, Life prediction. System thinking, etc. Various tools are being used to cany out the above stated investigation. These tools are Predicting of failure probability, asset life cycle, simulation analysis, Condition based monitoring, etc and computations intelligence based tools like Computerised maintenance management systems (C'MMS), Cost-benefit analysis, Fuzzy evaluation, etc.

"The Asset Management of Transmission and Distribution business operating in an electricity market involves the

central key decision making for the network business to maximise long term profits, whilst delivering high service levels to customers, with acceptable and manageable risks."

Asset Management is a formalised and systematic approach to the management of the physical assets of a network company. The aim is to remove any subjective and individualistic investment decisions by developing and implementing processes, which eventually become technology based, to provide an accurate picture of the complex issues relating to asset needs and focusing the options on delivering the required levels of transmission and distribution service performance, while maximising return. The result is that the best range of investment opportunities to meet an organisation's stated vision and objectives can be identified, quantified, delivered and operated.

OBJECTIVE

In order to support Asset Management, agencies must collect, store, manage, and analyze large amounts of data in an effective and efficient manner.

Although agencies have strongly emphasized collecting and integrating data, little effort has gone into linking the data collection to the agencies' decisionmaking processes. By focusing on the use of the data and the needs of the decision levels and processes to be supported, transportation agencies could define which assets and which data about these assets are more important for decisionmaking and tailor their data collection accordingly.

The objective of the investigation discussed in this report was to investigate how State departments of transportation (DOTs) are linking their data collection policies, standards, and practices to their Asset Management decisionmaking processes, especially for project selection. This decisionmaking level functions as an intermediate stage between high-level strategic decisions and low-level, project-specific decisions.

DATA COLLECTION FOR THE ASSET MANAGEMENT TECHNIQUES

Data collection, data management and data integration are essential parts of the AM framework that are critical to its success. Timely and accurate data lead to information and form the basis for effective and efficient decision making. Data collection is very much dependant ON the intended use of the data. It is obvious that the level of detail and the depth needed for the collected data varies according to the hierarchical level of the decisions that need to be made. Although all decision-making levels are undisputedly part of the overall AM process, data collection requirements have to specifically consider how the collected information is going to be used at the various management decision levels, Data needs for supporting strategic, network, or project level are significantly different in terms of degree of detail and required accuracy.

Broadly speaking the data collection requirements can be categorized in the following three groups:

- Location: actual location of the asset as denoted using a linear referencing system or GPR coordinates.

- Physical attributes: description of the considered assets that can include: material type, size, length, etc.

- Condition', condition assessment data can be different from one asset category to another according to the set performance criteria. The data can be qualitative and generic (e.g., Good. Bad, etc) or detailed and/or quantitative in accordance to established practices and standards (e.g., Pavement Condition Index, bridge health indices, etc).

Data Collection Methods : Infrastructure data collection has been an ongoing process since the 1960's. In the last decades the various methods and technologies used have shown a trend towards automation and computerisation.

Methods used for the collection of asset management data include: (1) manual. (2)automated. (3) semi-automated, and (4) remote collection. Regardless of the method used, the existence of an effective Quality Control and Quality Assurance (QC/QA) program is vital for the success and reliability of the collection. A brief description of each method is presented following:

1. Manual collection: The method employs two or more data collectors and a distance measuring device. The collected data are documented either with pen and paper or in most recent cases with hand-held computers.

2. Automated collection: The method involves the use of a ultipurpose vehicle which is equipped with a distance measuring device, digital video cameras a gyroscope, laser sensors, computer hardware. (AIMS systems. SCADA systems and potentially GPS antennas 111 order to capture, store, and process the collected data.

3. Semi-automated collection: This method involves similar equipment as the completely automated method but with a lesser degree of automation. It is very popular within transportation agencies and yields comprehensive and accurate data collection when properly implemented.

4. Remote collection: This last method pertains to the

use of satellite imagery and remote sensing applications. These methods involve high resolution images acquired through satellites or other types of images and scans obtained by remote sensing technologies (lasers, aerial photos, aerial GPR. etc).

Data Characteristics and Properties : The research of various sources on how agencies worldwide deal with AM Processes has brought to light particular attributes and characteristics that the collected data should possess in order to be useful for this purpose. Regardless of the particular type or category that the collected data fall into, it is of paramount importance that when incorporated 111 a database they exhibit the following characteristics:

- Integrity: whenever two data elements represent the same piece of information, they should be equal;
- Accuracy : the data values represent as closely as possible the considered piece of information;
- Validity: the given data values are correct in terms of their possible and potential ranges of values; and
- Security : sensitive, confidential and important data are protected by restricting access to them and by properly ensuring systematic and frequent "backing-up" in other storage media.

In addition, the Western European Road Directors (WERD) highlighted the importance of the following criteria when selecting data required by an agency/organisation:

- Relevance.- every data item collected and stored should support an explicitly defined decision need,
- Appropriateness- the amount of collected and stored data and the frequency of their update should be based 011 the needs and resources of the agency/organisation.
- Reliability - the data should exhibit the required accuracy, spatial coverage, completeness and currency,
- Affordability: the collected data are in accordance with the agencies financial and staff resources.

Decision Processes and Data Collection : Independent of the data integration strategy chosen and level of integration achieved, there are many dimensions inherent in the analytical and decision making processes concerning various assets that need be taken into account.

Decision processes can be either:

- At an operational level (e.g. how to repair an Engine) or
- At a more generalised strategic level (e.g. how often to remodel the engine).

Large and diverse amounts of data are needed in order to fully support the decision processes in all their possible dimensions and in all levels of decision making within the agencies. In addition, the resulting system's complexity is big enough to intimidate even carefully designed strategies and high levels of data integration that are chosen to be implemented. A carefully conceptualised thought process of rationalising which data are needed to support which type or level of decision processes needs to be developed.

Data should be collected according to their intended use and therefore data collection should be carefully planned according to these needs.

Decisions made at the different levels of Asset Management are heterogeneous and the supporting data needs are bound to be quite different. To systematically approach and identify the data needed to support Asset Management decision processes, it is necessary to first define the level of decision making these processes support. The data needed to support the various decisions at any of the various levels are different. Higher levels require more generalised information while lower ones tend to need more detailed and specific data.

ROLES & RESPONSIBILITIES

The Asset Management Model involves an understanding of both sides of performance, cost and risk management “doing the right things” and “doing things right”. This is ‘asset management’ and is usually implemented by developing clear organisational accountabilities between these two equally important utility functions Asset Management and Service Delivery. These two distinct functions require very different skill bases, cultures, processes and information systems to effectively deliver on their responsibilities. However, the two functions must work in close partnership to achieve a high level of performance.

These are the key roles of Asset Manager and Service Provider. In CIGRE Joint Task Force JTF23.18 also the role of an Owner has been mentioned. The role of the Owner is “giving direction ” as to where the

network company is heading. The responsibilities of the three distinct roles can be summarised as follows:

Owner – Accountable for the business strategy, the

direction of the network company and the overall financing of investments;

Asset Manager – Accountable for making investment decisions to balance asset/service performance, financial performance and risk;

Service Provider – Accountable for making decisions related to delivering work on time, within budget and in a safe manner in accordance with agreed specifications.

LITERATURE REVIEW

The concept of infrastructure management, particularly of transportation infrastructure management, is not new to the United States or to the rest of the world. In the second half of the 20th century, these efforts and approaches focused on managing individual transportation infrastructure asset types.

Pavement, bridge, tunnel, traffic equipment, congestion, public transportation, and various other types of management systems have emerged during the last decades. Ongoing research in these areas is producing important findings and is continually progressing. Pavement management systems are the oldest and most abundant of these engineering management systems because pavements constitute almost 60 percent of the total infrastructure assets managed by transportation agencies (Haas et al. 1994).

During the last decade of the 20th century, there was a slow but consistent movement toward a more holistic approach to the management of these assets. Transportation agencies in the United States and around the world began to acknowledge the merits of a more comprehensive methodology for managing their infrastructure. This holistic way of dealing with the management of transportation assets, coupled with more business-like objectives, has led to what is today commonly known as Asset Management.

Meanwhile, Asset Management has already been widely accepted by the private sector worldwide and has been practiced since the mid-1990s by transportation agencies in the United Kingdom, Australia, and New Zealand (Stalebrink and Gifford 2002). Hence, transportation agencies in North America had one more reason to investigate whether this was an approach that they wanted to endorse and apply (McNeil 2000).

Another milestone in the development of Asset Management has been the Statement No. 34, “Basic Financial Statements—and Management’s Discussion and Analysis—for State and Local Governments” (GASB 34), issued by the Governmental Accounting Standards Board (GASB 1999). This statement established a new financial reporting model for both State and local governments and has been regarded by many as the biggest change in history to public sector accounting (Wilson 2004).

CONCLUSION

The data needed to support the various decisions at any of the various levels are different. Higher levels require more generalized information while lower ones tend to need more detailed and specific data. The detail of information required and its correlation with the considered network size and the complexity of the analytical models used have a specific relation with the different levels of decision making.

The majority of the transportation agencies in the United States and the rest of the world have endorsed the concept of Asset Management. The state-of the-art has been steadily advancing, and various stakeholders have made significant contributions. However, Asset Management implementation is still at its initial stages, and there are many hurdles to overcome. In this respect, the development of integrated roadway inventories and databases is still underway in many agencies and so is the integration of individual management systems.

Transportation agencies in the United States have explicitly defined decision making levels and are moving forward to a rationalization of their data collection activities. Past agency practices and staff culture is still the predominant decision factor behind data collection, but they have started to give way to decisions based on data collection standards and input needs. In the particular area of project selection, there also seems to be a formally established relationship between the data collected and the decisions supported.

A data collection framework for project selection is recommended to optimize the data collection activities for project selection. The process provides clear and logical steps toward the complete rationalization of the data needs for these decisions. This framework, however, can only partially optimize the overall agency data collection activities because it only addresses project selection decisions.

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