ADVANCED TRANSPORT MONITORING SYSTEM FOR THE CAPE METROPOLITAN TRANSPORT AREA

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1. Introduction

Transport plays a key role in the functioning of a city. The Cape Metropolitan Council has identified a range of strategic themes including, targeting poverty and homelessness, strengthening the Cape Metropolitan Area as a global economic player, enhancing the environment, building social harmony and civic responsibility and developing local government.

The development, operation and maintenance of transportation systems will have an important impact on these strategic themes

In assessing the effectiveness of transport supply and management, strategic monitoring of pre-determined key performance indicators is essential. In order to do this transport data needs to be systematically collected, analyzed and disseminated. This relationship is depicted in Figure 1 below.

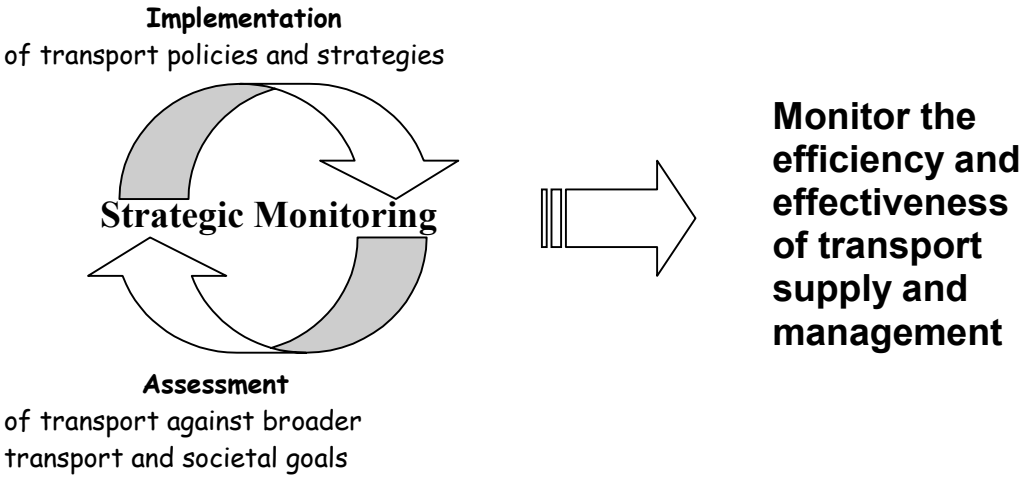

Figure 1: Strategic transport monitoring concept

Furthermore, to foster these strategic themes tactical monitoring of the operation of transport systems is also required. Tactical monitoring relates to both dynamic and historic forms of transport data.

The need to integrate these two data forms is based on the principle that today's dynamic [real time] data set is tomorrow's historic data set. The detail required for these tactical data sets is different to the strategic data set.

The concept of tactical monitoring is depicted in Figure 2, below.

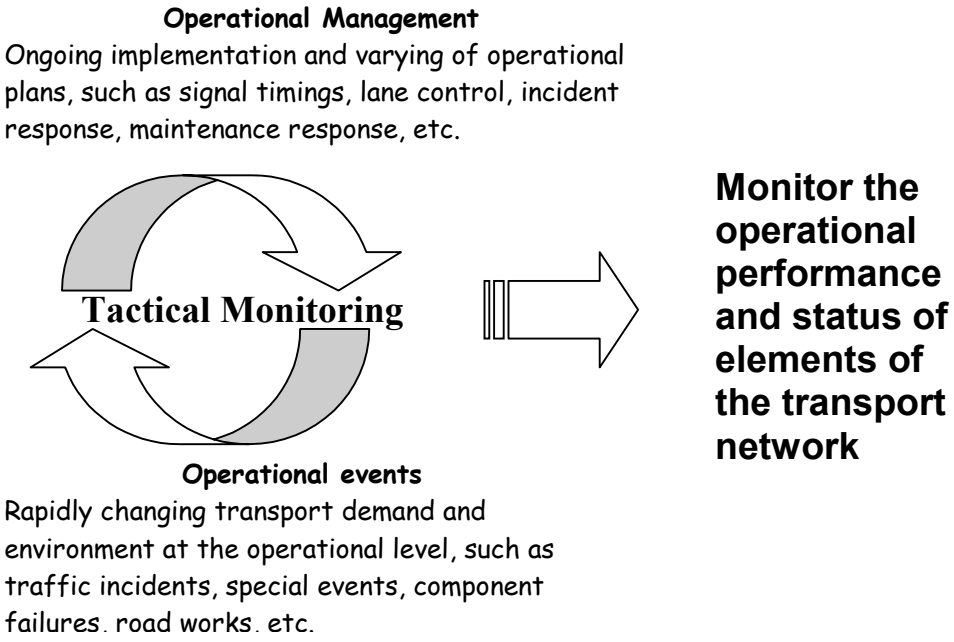

Figure 2: Tactical transport monitoring concept

2. Current Transport Monitoring Methods

This monitoring process has generally happened in a haphazard way. Up to ten transport and road authorities collect, analyse and interpret transportation data in the Cape Metropolitan Area. In addition, consultants and other organisations also collect transport data on an ongoing basis.

Usually the efforts are un-coordinated, often leading to a duplication of work, loss of quality, inaccessibility of information and results in inadequate and incomplete monitoring of transport, both at the tactical and strategic levels. The collection of data is poorly managed and often leads to data being "lost" or "delivered" late.

The beneficial effects of millions of Rands spent annually on transport provision is potentially compromised by the lack of an extensive tactical and strategic monitoring program.

Operationally the road network is often not utilized to its full potential due to a lack of real time knowledge about operating conditions. Response to incidents or equipment failure is often based on waiting for a report or complaint from the traveling public. This results in a relatively slow response to events [where the time factor is often critical] with consequential economic and safety losses.

Although transport agencies in the metropolitan area have over the past fifteen to twenty years amassed a vast amount of data, the data is generally difficult to access and analyze.

Annual traffic counts at over 150 sites, and at an additional 150 sites on a biannual basis, have been undertaken on an ongoing basis. Furthermore, between 200 and 300 intersections are counted in the metropolitan area every year. Operational monitoring of the road network is undertaken on an ad-hoc basis. Thousands of person-hours are spent annually collecting public transport data. This data collection and management is generally characterized by:

- uncoordinated data collection
- poor record keeping
- data not stored in suitable format
- difficult to acquire
- quality control difficult
- high cost

Spatial mapping of this data is difficult due to the format and storage medium. The potential to improve the efficiency and effectiveness of data management, in order to provide for the reliable monitoring of transport indicators, is immense.

Another problem is the vast array of independent software modules and data processing programs used to capture, save, analyze and disseminate data. None of the applications provides for easy integration.

3. Need to integrate applications

The advent of increasingly sophisticated instrumentation of the metropolitan freeways and arterials has heightened the problem even further. As part of the drive to improve the efficiency of traffic monitoring an Automatic Traffic Recording [ATR] System has been developed in conjunction with the Metropolitan Area Traffic Control System. In addition a range of other automated data collection devices are currently being deployed on the metropolitan road network. The data from these sources is of both strategic and tactical value.

Tactically, the data provides a real time picture of the operational status of devices on the road network as well as an overview of the real time characteristics of traffic flow. The metropolitan area traffic control system also provides a real time indication of congestion on the arterial network. Over 1000 loops continuously monitor traffic flows through intersections on a second by second basis.

Traffic signal timings on major corridors are adjusted in real time to respond to variations in flows and traffic patterns. These facilities currently save motorists in the metropolitan area more than three million Rand a month in user operating and time costs.

Projects are currently underway to develop a system to monitor flow conditions on the metropolitan freeways. These systems will provide a vast array of real-time traffic data.

Strategically, the traffic count data is currently used to monitor traffic growth on the Metropolitan road network. It is also used in strategic transport modeling and for traffic engineering projects of a tactical nature.

However, no systems are in place to systematically map and integrate this data with other applications and provide a seamless data management system.

The ATR system provides information from about 500 count sites on a 24-hour basis. Some of these sites coincide with the manual count program, while some are undertaken at new locations. On a typical day, in excess of 200 000 items of information are transmitted to the central computer.

In order to overcome the shortcomings of existing methods an integrated system to collect, store, analyze and disseminate data on a metropolitan scale is required. This system should provide:

- common standards throughout the metropole,
- integration of data collection and dissemination processes and procedures,
- automation of data collection, where feasible,
- automation of responses to operational performance indicators, where feasible, and
- permanent and easily retrievable record of critical events and required data sets

4. What the Transport planning and management sector requires

Without an integrated system to collate the data from these various sources the full benefit of the information will not be realized. The vision for the management and provision of transport data in the metropolitan area is to provide:

reliable operational and strategic transport data, immediately available, and readily accessible

In order to achieve this vision a systematic approach to the collection, storage, analysis and dissemination of data is required. The primary objective of the system is to monitor the tactical operation and strategic performance of metropolitan transport facilities and disseminate the collected information timeously and in a suitable form.

It is envisaged that the system will be used by transport and urban planners, traffic engineers, traffic managers, civil engineers, systems operators, maintenance personnel and other groupings associated with transport and related service delivery. In addition to the primary use, it is envisaged that the system will also provide accurate and up to date information to the travelling public.

Integration is critical to the successful realization of this vision. The conceptual plan for this is depicted below in Figure 3.

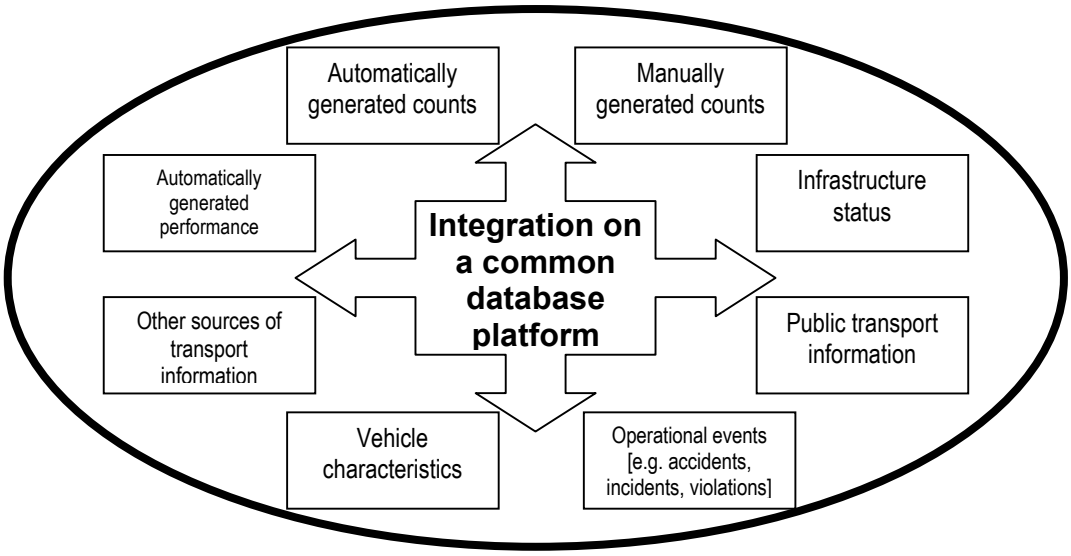

Figure 3: Conceptual architecture for information integration

The development of an integrated database will provide the following benefits:

- ready access to information
- correct format
- improved tactical response
- strategic monitoring capability is improved
- automatic integration into various applications
- control quality of data
- reduction in data collection costs
- improvement in the productivity of staff resources

The improvement in the efficiency and effectiveness of data management will be further enhanced by spatially mapping this data. The resulting spatial integration of transport related information at a metropolitan level would enable the efficient collection and sharing of information among the various local, metropolitan, provincial and national government structures responsible for transport facilities in the Cape Metropolitan Transport Area.

5. The envisaged system

The development of an integrated transport data management system is underway. This development process will culminate in an **A**dvanced **Tra**nsport **M**onitoring **S**ystem, called **ATraMS**. The metropolitan system will facilitate efficient and effective planning, maintenance, and operation and monitoring of, initially, road-based metropolitan transport facilities. It is envisaged that the system will be expanded to other forms of land transport.

Although when looking at individual components, the system offers little that is new, the innovation is in the integration of the range of features onto a common platform, with a flexible interface serving a wide range of tactical and strategic needs.

The system is being developed around the existing metropolitan geographical information system. An Oracle database will provide a data warehouse for all transport related information.

The system will allow access via a range of tools, providing a service to both "thick" and "thin" clients in real time and historic reference modes. A conceptual overview of the system is shown in Figure 4, below:

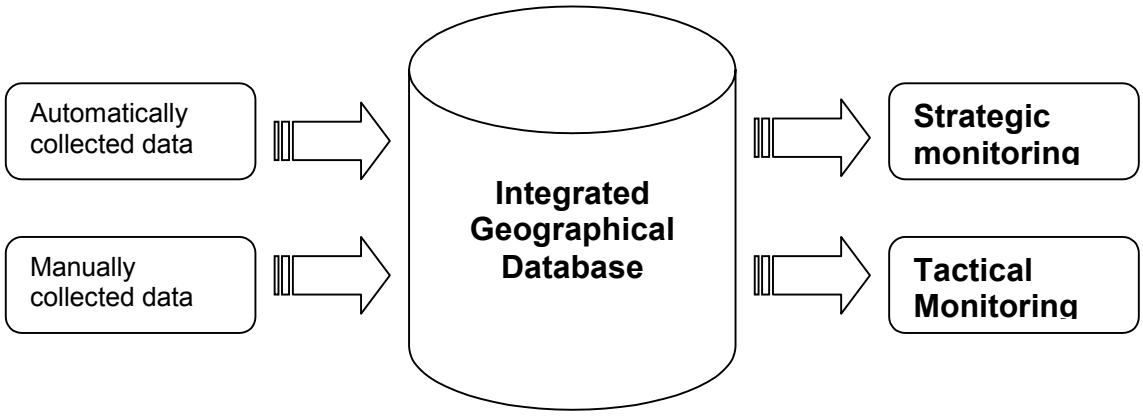

Figure 4: conceptual overview of the ATraMS system

It is envisaged that the project will be phased over a number of years. The phasing relates to the density of the data collection as well as the range of functionality. The system will be mounted on a series of networked hardware platforms with a pre-processing interface to the metropolitan Intelligent Transport System. Additional software modules and interfaces will be provided to users. The system will provide a web based [browser] interface as an alternative.

The system allows both historic time series evaluation of data as well as dynamic output of real time data and will provide real time messaging to responsible parties to report on critical operational conditions.

6. Summary and Conclusions

In order to improve the way in which functions relating to road-based transport planning, maintenance and operations are coordinated and executed in the Cape Metropolitan Transport Area, a tool for efficiently and effectively collecting, collating and disseminating transport related data is being developed.

The primary objective of the project is to implement a system for monitoring the tactical operation and strategic performance of metropolitan transport facilities and disseminating the collected information timeously and in a suitable form. It is envisaged that the system will be used by a wide range of groups associated with transport operations, planning and related service delivery. In addition to the primary use, it is envisaged that the system will also provide accurate and up to date information to the travelling public.

The integration of transport related information at a metropolitan level should enable the efficient collection and sharing of information among the various local, metropolitan, provincial and national government structures responsible for transport facilities in the Cape Metropolitan Transport Area.

The development process will culminate in an Advanced Transport Monitoring System, called ATraMS. The metropolitan system will facilitate efficient and effective planning, maintenance, operation and monitoring of, initially, road-based metropolitan transport facilities.