cITIEs SUPPORT PROGRAMME

Towards sustainable city transport systems

Practice note: Intelligent Transport Systems

Bus Rapid Transit (BRT) and City Bus Systems require sophisticated, complex – and often costly – information and communication technologies. The massive amount of data generated through these technologies via diverse sources such as ticketing systems, Global Positioning Systems, sensors and even commuter smartphones, requires constant analysis for improved operations and decision-making. Ensuring that Intelligent Transport Systems (ITS) are correctly scoped, costed, procured and managed can be challenging – and financially risky. This Practice Note provides an overview of ITS with a focus on benchmarking of costs – that if considered during the planning phase will ensure cost-effective and efficient systems that are locally supported, fit for purpose and deliver optimum benefit.

Context

The Cities Support Programme (CSP), based in the National Treasury, provides technical support to selected metropolitan municipalities to pursue a programme of urban spatial transformation to support inclusive economic growth and poverty alleviation. An important aspect of this support is directed at the public transport programme. There are three broad areas around which the transport programme is structured:

1) Creating an enabling national legislative, institutional and policy environment for the development of city public transport systems
2) Supporting the planning and roll-out of public transport systems that are efficient, effective, provide value for money, and respond to the transport needs of the poor
3) Ensuring that public transport systems are drivers of spatial change

See the CSP website (https://csp.treasury.gov.za) for updates and the latest materials on sustainable city transport systems.

Working with the National Department of Transport, the CSP is involved in providing support to the cities in creating more financially sustainable public transport systems. This Practice Note is aimed at this, by specifically looking at ITS.

What is ITS?

ITS stands for intelligent transport system. Put simple, it is information communication technology + transport. ITS is therefore the use of information and communication technology in transport systems. Information technology is an important component of high-quality BRT and City Bus Systems. Services are designed to cater to large passenger volumes and must deliver fast, accurate and reliable services in the form of financial transactions, customer information, and operations systems. ITS addresses the complexities of day-to-day operations management and if applied sensibly can contribute to sizeable cost savings. ITS assists in the management of bus operations from a central control center. ITS is typically used for:

- Operations monitoring
- Customer information
- Fare collection
- Signal control
- Fleet management
- Surveillance system

Within the context of BRT and City Bus Systems, ITS is typically deployed for implementation of an Advanced Transport Management System (APTMS). APTMS includes bus scheduling, driver monitoring, passenger information, passenger counting, bus tracking, CCTV monitoring and security. Automatic vehicle monitoring (AVM) systems help the BRT and City Bus System maintain planned headways. They also allow the Central Control Centre to respond to unexpected levels of demand, disruptions, and emergencies such as bus breakdowns, riots, or traffic jams.

At an operational level, data generation is central to ITS and its value to transport systems. If data cannot be generated, managed, curated and implemented for the smart management of a system's performance, then the ITS project will not have met its primary objective – the proactive management of BRT and City Bus Systems.

It must be emphasised that ITS can both monitor service delivery and proactively manage BRT and City Bus Systems.

Some core features of ITS:

- Know what buses should be doing
- Know what buses are doing
- Collect payment for transport from users as easily and securely as possible
- Take all the data generated into consideration in order to improve the system

Problem statement

Most cities are planning for Integrated Public Transport Networks (IPTNs) consisting of the integration of different modes of transport, including implementing BRT and City Bus Systems and utilising rail capacity where it exists. Experience from the cities that are currently operating BRT and City Bus Systems shows that the running costs of these services are significantly more than predicted, and that fare revenues are falling short of initial projections. This poses a challenge for the future sustainability of such systems. ITS contributes a significant portion of these costs at approximately 21% of total indirect system costs.

ITS is complex and highly specialised and can easily be over-designed and costed. During the planning phase of a new BRT or City Bus Systems, it is important that ITS specifications should be realistically set, adequately reviewed and a minimal or 'bare-bones' approach followed. During the procurement process, the selection criteria should be carefully designed in advance and the evaluation and selection team must include relevant in-house and external experts. Proposals should be reviewed by experts to ensure the best system but also consider all potential long-term technical implications. Lastly, contracts should consider the real risk of clients being locked into supplier agreements that may be difficult to end.

The challenges of implementing ITS systems include:

- Cities 'copying and pasting' ITS specifications from other cities
- Issues with interoperability, eg BRT ITS systems not being able to communicate with a metrobus ITS
- Poor functioning systems that are often amended at a high cost
- The procurement of non-essential ITS components at a high cost
- Very expensive procurement contract values, particularly for maintenance
- Over-specification of equipment, as well as an over-designed and inefficient system
- Inflexible fare products and constant failures of the fare collection systems that may result in poor bus services, payment evasion and illegal sales
- ITS systems that are fit for purpose in Europe (for example) but not suitable for the South African context
- Unnecessarily high standards imposed by policy at a national level resulting in costly and difficult to implement systems at a city level
- Limited in-house skills and capacity to manage ITS systems

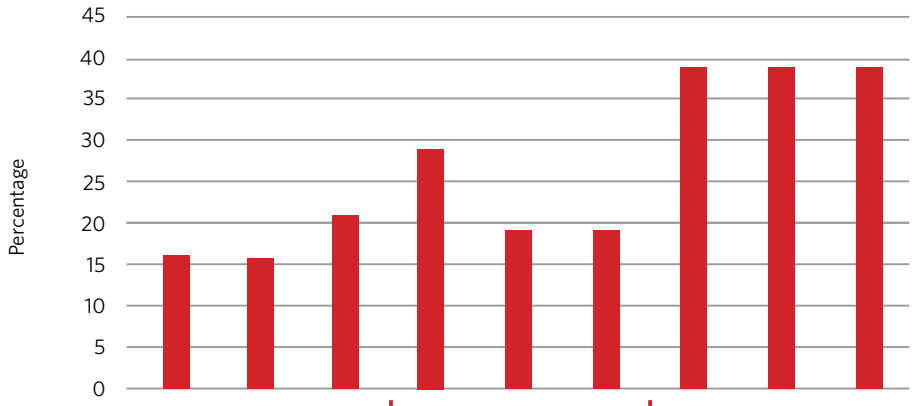
Implementing ITS using a modular approach

Best practice indicates that a 'step-wise' or modular approach can help cities deal with the complexity of implementing ITS. A 'step-wise' approach ensures that there is a central objective to the implementation of technology at each stage that is focused and is delivered upon before moving to the next stage. This requires clarity on what the 'core' objectives are – and therefore the core needs – of the technology systems required during the different stages of rollout. Based on these goals and objectives, a strategy for ITS can then be adopted to guide implementation and deployment of technology at appropriate scale across stages. Before progressing with ITS deployment, it is imperative that the core technology systems are functioning and deliver value and return on-investment.

As a BRT's and City Bus Systems performance increases and demand/usage grows, there will be an increase in complexity and deployment of technology. So too the needs of ITS will become more complex. In other words, different categories and levels of technology are introduced at different stages of complexity in operations, on a 'fit-for-purpose' basis. This should however be considered and planned for upfront to ensure the smooth transition from one stage of deployment to the next and that critical prerequisite conditions are kept in mind.

Intelligent Transport Systems (ITS) costs as a % of total fare revenue

(figures are extracted from 2018/19 - 2020/21 MTEF budget figures)

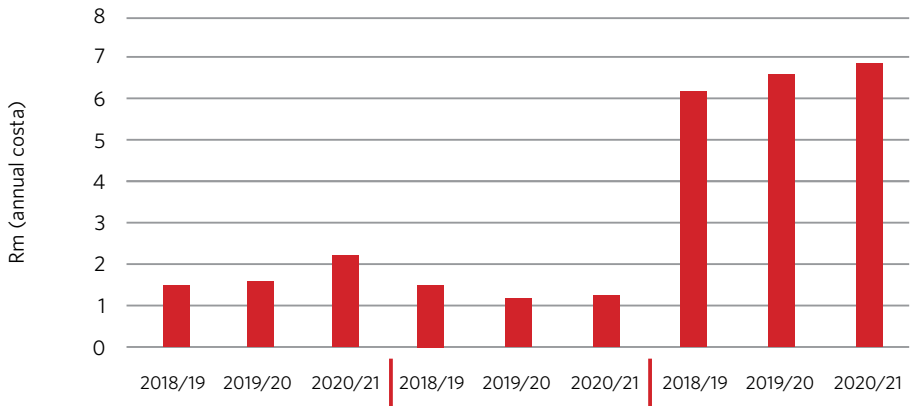


	2018/19	2019/20	2020/21	2018/19	2019/20	2020/21	2018/19	2019/20	2020/21
ITS costs - Rm	73.2	77.4	121.9	90.2	59.4	63.2	67.8	71.9	76.2

Cities

Average Intelligent Transport Systems (ITS) costs per staffed station

(figures are extracted from 2018/19 - 2020/21 MTEF budget figures)

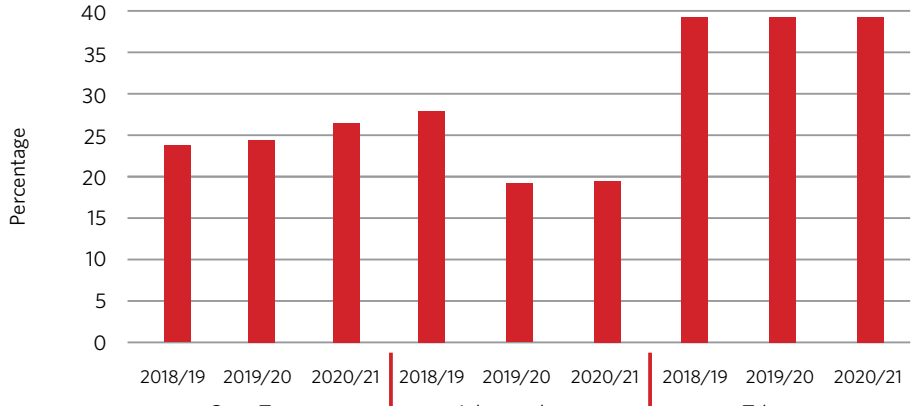


	2018/19	2019/20	2020/21	2018/19	2019/20	2020/21	2018/19	2019/20	2020/21
Average Station services cost per staffed station - Rm	1.5	1.6	2.3	1.5	1.2	1.3	6.2	6.5	6.9

Cities

Intelligent Transport Systems (ITS) as a % of total indirect operating expenditure

(figures are extracted from 2018/19 - 2020/21 MTEF budget figures)



	2018/19	2019/20	2020/21	2018/19	2019/20	2020/21	2018/19	2019/20	2020/21
ITS Costs - Rm	73.2	77.4	121.9	90.2	59.4	63.2	67.8	71.9	76.2

Cities

This example illustrates the approach:

- Operational Planning – Objective? To have sound and functional business processes running that are operational, and that can be powered by ITS

It is important to understand upfront that ITS is not an operational plan. An Automatic Vehicle Monitoring (AVM) system can facilitate improved dispatching but it cannot substitute for proper planning and processes.

- Performance Monitoring - Objective? To match real-time operations to the operational plan for financial management, service delivery and reporting
- Reporting and Data Sharing - Objective? Business Process Improvement in all departments to integrate data flows from ITS to power management processes
- Service Optimisation - Objective? Proactive use of data from ITS in improving operations with a goal to reduce costs (fuel, tires, vehicles) by matching supply with demand efficiently

Example of a possible step-wise approach to ITS deployment for APTMS

Based on best practice research, the following expenditure guidelines can be applied per stage according to the size of the BRT and City Bus Systems. (Remember that city size and economic activity will drive the needs and characteristics of the public transport network deployed for that city.)

Percentage of ITS costs over 12 years

Daily ridership	Up to 20,000	2,000 to 80,000	80,000 to 250,000
Fleet size	200	600	2000
ITS costs (12 years)	R136 601 088	R399 300 392	R1 102 385 224
Stage 1 – Operational planning (year 1 and 2)	7.6%	6%	67.6%
Stage 2 – Performance monitoring (year 3 to 6)	64.2%	64.7%	67.2%
Stage 3 – Reporting & BI (year 7 to 8)	9.3%	18.4%	19.2%
Stage 4 – Service optimization (year 9 to 12)	18.9%	10.9%	7.3%

Hints:

- Define the milestones for each stage
- Milestones should be based on the system size (based on anticipated daily ridership)
- Do not move on to the next stage without passing the requirements of the previous stage
- Do not introduce new technologies – rather mature and improve the existing systems and operations will subsequently improve due to harnessing the appropriate data

Benchmarking ITS costs

South African cities have spent too much for ITS systems to date. However, there are a number of reasons for this, including inadequate systems design, deficient tender and contract documentation, inadequate in-house expertise and experience, escalation and inflation, as well as foreign exchange fluctuations affecting the price of goods and services.

The table below shows the ITS expenditure for three different city sizes and levels of maturity as a percentage of fare revenues. It indicates that with pragmatism and the use of a modular approach, the percentage of ITS expenditure can be kept at between 15-20% of fare revenues. For larger cities this might even be less than this as economies of scale can be realized in these cities. Most importantly, cities will have to guard against over-designed systems and ensure that operational plans are properly planned and managed to meet this target. Currently poor management and inflated system requirements (leading to costly procurement) is driving costs higher.

Costs benchmarked as percentage of projected fare revenue per city size

City size	ITS total cost as % of fares	Non-fare - related ITS costs	Non-fare % of revenues	Fare system ITS costs	Fare system % of revenues
Population less than 500,000	19.0%	R71.2 million	9.89%	R65.4 million	9.08%
Population between 500,000 and 2,000,000	18.5%	R227 million	10.51%	R172 million	7.97%
Population larger than 2,000,000	12,8%	R650 million	7.52%	R45.2 million	5.24%

Implications for practice

Reducing the complexity of ITS requires a step-by-step approach across all systems. Only then can needs and challenges be addressed as cost-effectively as possible and interventions implemented in an incremental fashion. With key functions and outcomes in mind, a modular and incremental approach is needed to ensure that the technology is appropriate, flexible and sized-to-fit. By following such an approach, there is greater room for trial and error and reducing significant upfront and risky investment in technology.

Cities need to benchmark like with like, against other cities, to compare the prices across cities.

Cities need to revisit their ITS roll-out plans on a continuous basis, reviewing ridership levels and fare revenues to ensure that ITS expenditure is being kept in line with the ITS expenditure levels as a 15-20% percentage of fare revenue. If ridership is behind projections, or fare revenues are less than what was modelled and expected, then ITS expenditure should be reviewed with a focus on providing essential management services and passenger information systems. ITS expenditure should be tied to the performance of the system in terms of riders and revenues, and not be an isolated system cost that is implemented without cognisance of the performance of the operating environment.

Recommendations

- Approach ITS strategically
- Follow a minimal or 'bare bones' approach
- Spend time learning and understanding available technologies
- Issue requests for information or expressions of interest as a precursor to tendering
- Follow a step-by-step, incremental and modular approach
- Know the available technologies
- Ensure all technologies are integrated and can "speak to each other"
- Use internal and external experts throughout the procurement process
- Learn from the experience of other cities

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