TRANSPORT TECHNOLOGY AND INNOVATIONS IN NIGERIA

Policy Guides to A Sustainable Future

Dr. Bayero Salih Farah FCILT, FCIOTA | Dr. Joshua A. Odeleye FCILT

TRANSPORT TECHNOLOGY AND INNOVATIONS IN NIGERIA: POLICY GUIDES TO A SUSTAINABLE FUTURE

Edited by
Bayero Salih Farah | Joshua A. Odeleye

Transport Technology and Innovations in Nigeria: Policy Guides to A Sustainable Future

Edited by
Bayero Salih Farah | Joshua A. Odeleye

A Publication of the

NIGERIAN INSTITUTE OF TRANSPORT TECHNOLOGY (NITT)
ZARIA, 2022

Contents

Chapter 5

Feasibility of Implementing Intelligent Transport System (ITS) In Zimbabwe: A Case Study of Harare

Tapiwa Christopher Mujakachi, Araoye Olarinkoye Ajiboye, Sibongile Manzini and Muhammed Etudaiye Ohida

5.1 Introduction

Conventional transportation systems comprise mostly road in developing countries, are experiencing significant and ever-growing pressure during the past several decades due to the continuous motorization and urbanization around the world (Ezzel, 2010). Over half of the world's population (54%) lives in cities in today's increasingly global and linked world, while there is still significant variation in urbanization levels across countries. The size and spatial distribution of the world population will continue to alter dramatically in the future decades. By 2050, continued urbanization and global population growth are expected to add 2.5 billion people to the urban population, with approximately 90% of the increase occurring in Asia and Africa. Simultaneously, the share of the global population living in cities is predicted to rise, reaching 66% by 2050. (Watson, 2014). Rapid urbanization has led to and will continue to lead to a rise in urban population and further motorization; demand for automobiles is also fast increasing. According to (Prabha et al.2016), transportation has become increasingly problematic as a result of high accident rates, traffic congestion, and carbon emission. With growing car ownership and the projected rapid growth of metropolitan perimeters in under-planned agglomerations, urban mobility in emerging countries is expected to deteriorate in the twenty-first century.

This will result in increased traffic congestion, which will inevitably lead to increased complexity.

The creation of "Intelligent Transport Systems" has resulted from the application of information and communication technology (ICTs) in the transportation sector (ITS). ITS improves traffic efficiency and safety, which has a good impact on long-term growth. ITS are increasingly being employed by developing countries, who are confronted with urgent needs to improve traffic in quickly growing cities. ITS were initially driven mostly by more sophisticated countries (the United States, Japan, and some European countries). ITS are also becoming more suited to the needs of developing countries, and recent advancements in Information and Communications Technology (ICT), such as the analytical power provided by open and big data, have increased the likelihood that ITS will be designed in developing countries to meet their specific needs (Economic and Social Commission for Latin America and the Caribbean, 2013).

Even though there has been a lot of progress in the field of transportation infrastructure over the last two decades, numerous traffic challenges are becoming more prevalent every day. This is primarily due to an increase in the number of automobiles on the road. Almost every country in the globe, whether developing or developed (the classification of developed and developing countries is based on the International Monetary Fund's World Economic Outlook Report, April 2012), is grappling with transportation management issues (Singh and Gupta, 2013). Countries all across the world are moving their attention from infrastructure construction to making the best use of the infrastructure facilities that are already in place (Singh et al., 2014). ITS is being developed and used all over the world to make the best use of available transportation infrastructure. Several attempts to alleviate traffic problems using technology have been made, especially in developed economies with the financial means to fund ITS research and development, testing, and deployment. This is not the case in developing countries such as Kenya, Rwanda, Tanzania, Tunisia, and Zimbabwe, which are grappling with a slew of other "life-threatening" issues such as access to safe and clean drinking water and food security, leaving them no choice but to ignore or at the very least postpone the implementation of ITS solutions, opting instead to rely on legacy technologies that are not only obsolete but also costly in the long run (Chikutukutu, 2017). In this study, we looked at four important aspects of the

ITS, namely Advanced Traveller Information, Advanced Traveller Information, Advanced Traveller Information, and Advanced Traveller Information.

There is a growing body of knowledge about the widespread use and undeniable benefits of ITS around the world (Ezell, 2010, Singh et al., 2014, Wamboye et al., 2015). These literatures, on the other hand, is mostly focused on the adoption and use of ITS in industrialized countries. Despite the fact that the Economic and Social Commission for Asia and the Pacific (ESCAP) secretariat (ESCAP, 2013) noted that ITS is increasingly being used by developing countries that are faced with urgent needs to improve traffic in rapidly growing cities, the majority of developing country cities, particularly in Sub Saharan Africa, are still lagging behind on ITS adoption. This assertion is well supported by (Gyamfi, 2005), who stated that "Sub-Saharan Africa (SSA) is the least advanced of all regions of the world in information technology. It's against this background this study seeks to examine the possibility of implementing an ITS in Harare in order to boost traffic and incident management within the Central Business Areas.

5.2 LITERATURE REVIEW

5.2.1 Concept of Intelligent Transport System (ITS)

ITS refers to a wide range of wireless and wireline communications-based information, control, and electronics technologies that are embedded in the system's infrastructure and vehicles to alleviate traffic congestion, improve safety, and boost productivity, saving lives, time, and money (Intelligent Transportation Society of America, 2010). According to Balaji and Srinivasan (2011), ITS is an integrated system that uses a wide range of communication, control, vehicle sensing, and electronics technologies to aid in traffic flow monitoring and management, congestion reduction, providing optimal routes to travelers, increasing system productivity, and saving lives, time, and money. According to Levine, Grengs, and Shen (2009), ITS is a tried-and-true method of reducing traffic congestion by utilizing technology to improve transportation systems, with the primary goal of evaluating, developing, analyzing, and integrating new technologies and concepts to improve traffic

efficiency for pedestrians and other traffic groups. According to a synthesis of the above criteria, the field of ITS presents a range of new techniques for solving difficulties such as safety, mobility, congestion, the environment, and consumer satisfaction (Barcelo et al, 2012).

5.2.2 Infrastructure level V2I (Vehicle to Infrastructure)

A satisfactory solution to all of these ITS infrastructure requirements appears unattainable at first glance. However, transportation technology research and development provide hints as to the shape that the transportation infrastructure could take to achieve maximum efficiency.

This summary gives analyst some insight into which technology advancements in transportation engineering are the most likely to last. V2I enables the vehicle to have direct communication technology advancements in transportation engineering are the most likely to last. V2I enables the vehicle to have direct communication with transport infrastructures. Drivers can be notified and avoid crashes, according to Karen Timpone (2013), when automobiles, buses, trucks, and emergency vehicles are able to "speak" to traffic signals, stop signs, crosswalks, and other features of the surface transportation system.

The V2I relationship is represented below, in which road traffic components, their relationships, and linkages to environmental infrastructure, such as toll gates, are linked with vehicles and other supporting systems. All traffic data is gathered and administered by a central system that also transmits the current state of all actors in the environmental scenario, such as between vehicles, operators, and infrastructure, using cameras and number plate detection (boom

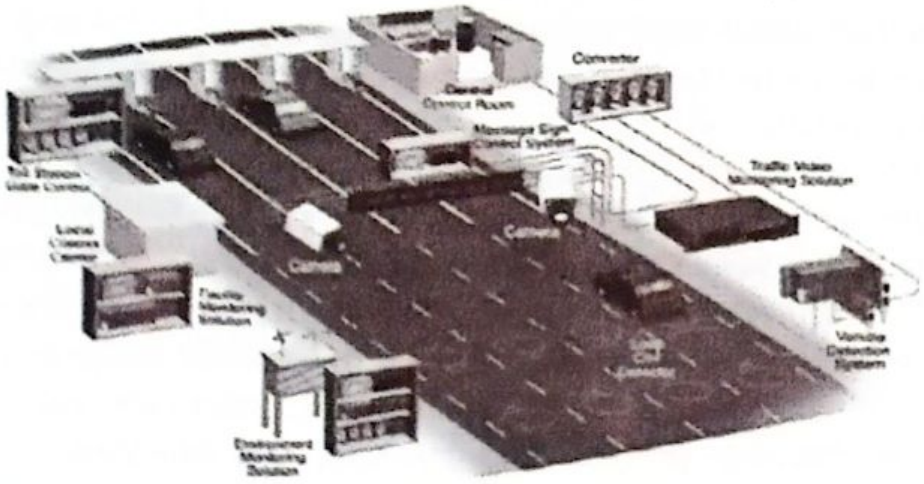


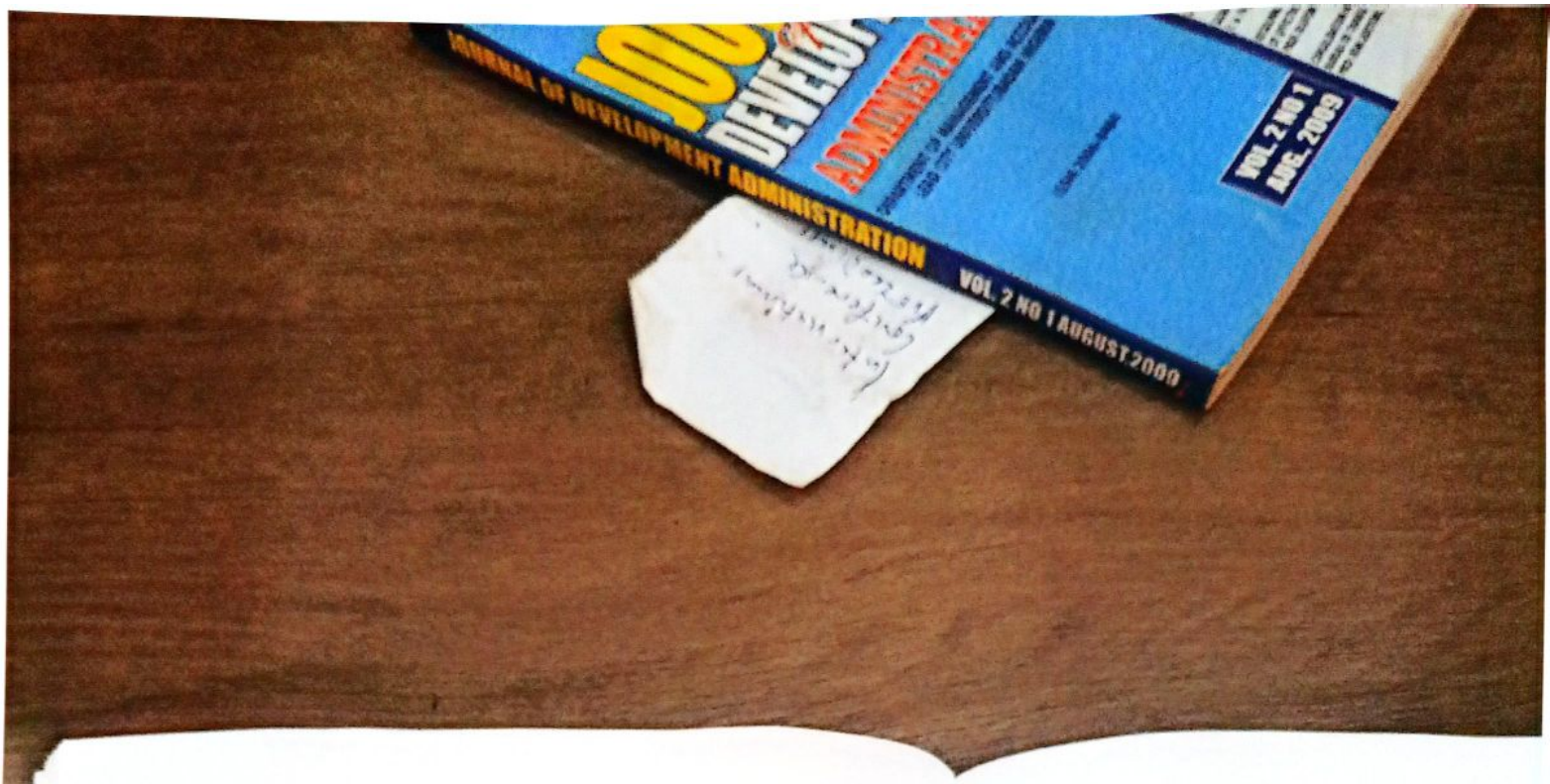
Fig 5.1: Showing Vehicle to infrastructure communication.
Source: (BošnjakZagreb, 2006)

5.2.3 Assessing Intelligent Transport System Components and Uses

In industrialized countries, ITS is utilized for real-time navigation, traffic updates, lane discipline, and travel time prediction. Its purpose is to increase the road transportation system's efficacy, efficiency, and safety. GPS receivers embedded in vehicles' on-board components (OBCs) collect motion data from a variety of satellites to determine the vehicle's position. According to Singh (2014), GPS requires a clear line of sight to satellites, which can make it difficult to utilize GPS in urban areas owing to "urban canyon" effects. It is frequently possible to pinpoint a location to within ten meters. Many in-vehicle navigation and direction guidance systems rely on GPS for their operation.

Potholes are a major source of concern, and they can be found on every road. If it is not properly maintained, it will expand in size day by day (Eriksson et.al, 2013). According to Mohan (2008), smartphone sensors such as the accelerometer, GPS, and GPRS are used to determine the location of a pothole and send the information to a central server.

DSRC is a short- to medium-range wireless communication channel designed for automobile applications that operates in the 5.8 or 5.9GHz radio frequency (Hasan, 2010).



Through embedded tags or sensors, DSRC enables two-way wireless communications between the vehicle and roadside equipment (RSE). DSRC, according to Angin et al. (2010), is a key supporting technology for a variety of intelligent transportation systems, including vehicle-to-infrastructure integration, vehicle-to-vehicle communication, adaptive traffic signal timing, electronic toll collection, congestion charging, electronic road pricing, and information provision. Radio frequency identification (RFID) is a subset of DSRC technology to- infrastructure integration, vehicle-to-vehicle communication, adaptive traffic signal timing, electronic toll collection, congestion charging, electronic road pricing, and information provision. Radio frequency identification (RFID) is a subset of DSRC technology.

Wireless networks, which are similar to the technology used for wireless Internet access, allow for quick communication between vehicles and the roadside but have a limited range of a few hundred meters. Brett Hull et al. (2006) proposed a computing system for collecting, processing, delivering, and visualizing data from smartphone sensors. The data from the sensors is wirelessly transmitted to the central server through Wi-Fi or Bluetooth, where it is saved in a database for further analysis and visualization. The data from the mobile nodes, which are the mobile phones, will be carried by nodes located along the roadside.

ITS applications can communicate data over typical third (3G) or fourth generation (4G) mobile telephone linkages. Benefits of mobile networks include widespread availability in towns and along main roads. Though additional network capacity may be necessary if vehicles are fitted with this technology, and network operators might need to cover these costs (America IT 2010).Ezzel, (2017) further argued that mobile telephony may not be suitable for some safety-critical ITS applications since it may be too slow

To broadcast real-time traffic information, Japan's Vehicle Information Communications System (VICS) uses radio wave beacons on expressways and infrared beacons on trunk and arterial roads (Taylor and Steven 1997). Arterial roadways, according to Karen, (2013), are medium-capacity roads

that are just below freeways in terms of ser
arterial roadways typically use traffic signals.

Large amounts of traffic are transported betw
arterial highways. Wireless technology used t
Patterns based on cameras or tags can be us
such as in London, or for charging on specif
cameras installed on highways where m
areas.

The cameras, according to Taylor and St
Plate Recognition (ALPR), which is base
(OCR) technology, to recognize vehicle li
sent digitally to back-office servers, whi
for using roadways within the traffic pro

5.3 Research Methodology

The inductive and positivism philoso
aim of this study is to examine the f
traffic management, the interpretivis
study. This research philosophy hel
to the adoption of ITS. This is also
respondents are interpreting event
especially the challenges being exp
The authors use both qualitative a
In this study, the researcher has
feasibility of adopting ITS in Har
the research is intrinsically motiv
particular City in order to get a h
is particularly special and the fi
in order to provide the uniqu
2002).

The data collected was throu
observation and questionnair
version 15. The researcher us

that are just below freeways in terms of service; a notable contrast is that arterial roadways typically use traffic signals

Large amounts of traffic are transported between locations in urban centers by arterial highways. Wireless technology used by VII is 5.9 GHz DSRC

Patterns based on cameras or tags can be used for congestion charging zones, such as in London, or for charging on specific roadways. These systems rely on cameras installed on highways where motorists enter and exit congested areas.

The cameras, according to Taylor and Steven (1997), use Automatic License Plate Recognition (ALPR), which is based on Optical Character Recognition (OCR) technology, to recognize vehicle license plates; this information is then sent digitally to back-office servers, which assess and post charges to drivers for using roadways within the traffic problems zone.

5.3 Research Methodology

The inductive and positivism philosophy was adopted for this study. Since the aim of this study is to examine the feasibility of adopting ITS in Harare City traffic management, the interpretivism or phenomenology is adopted for this study. This research philosophy helps to establish how people are responding to the adoption of ITS. This is also important because it helps to see how the respondents are interpreting events or how they feel about the change process especially the challenges being experienced and how they are being addressed. The authors use both qualitative and quantitative approach for this study.

In this study, the researcher has particular interest on how to examine the feasibility of adopting ITS in Harare City traffic management. For this reason, the research is intrinsically motivated and the investigator focused only on this particular City in order to get a holistic and in-depth understanding. This case is particularly special and the findings will be compared with existing theories in order to provide the unique characteristics from the findings (Rowley, 2002).

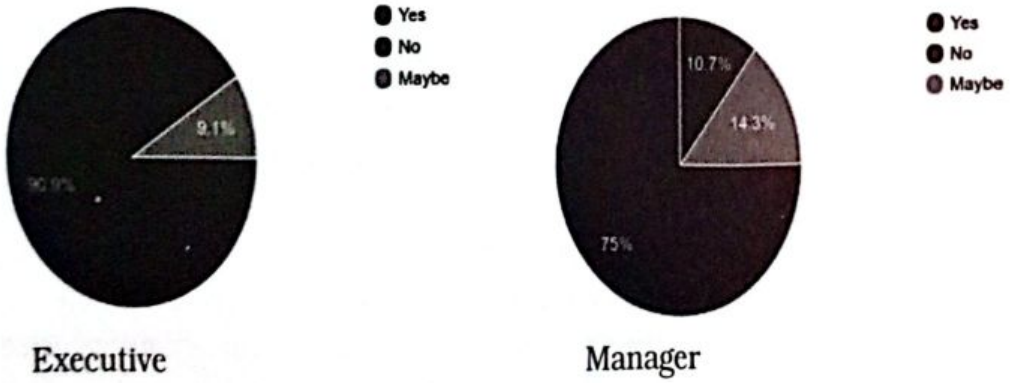
The data collected was through interviews, direct observations, participant observation and questionnaires. However, the data was analyses using SPSS version 15. The researcher used the non-random sampling approach for both

interviews of the Executives and also for the questionnaires for middle managers and supervisors. The basis for using this approach was based on the fact that all executive members were supposed to be involved in the adoption of ITS, hence the researcher wanted to establish how each executive member was doing it.

5.4 Data Analysis and Interpretation

5.4.1 Importance of ITS

90 percent of senior management executives reported that ITS is of paramount importance whilst 9 percent were indifferent at the same time, 75% of middle line managers indicate in the importance of ITS whilst on the contrary 10.7% felt that ITS is not an important and the remaining 14.3% were indifferent to the matter, this is shown in the figure below.



Executive Manager

Fig 5.2: Importance of ITS to Management

The research noted with great concern that for those who were indifferent or against adoption of ITS were either ignorant of ITS or had been misinformed about its benefits and may have been merely having fear of the unknown.

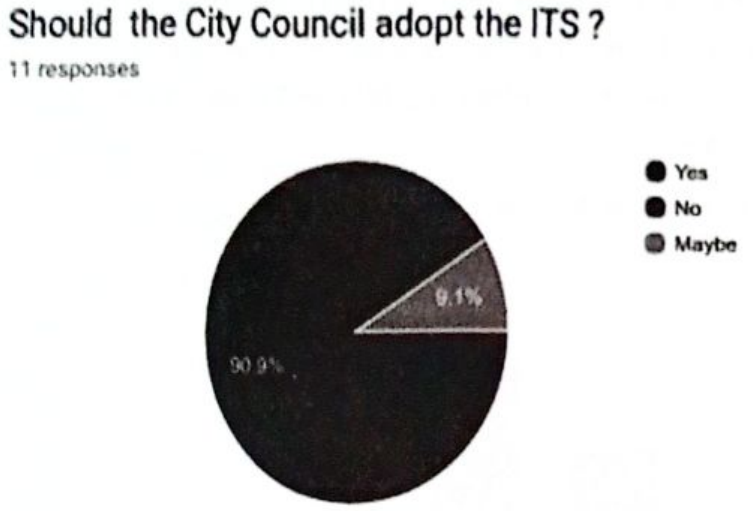


Fig 5.3: Semi Structured Executive Interview

As shown above in figure 5.3 the majority of executives (90%) believe in the importance of ITS whilst the remainder were indifferent. The explanations on how ITS can improve the performance and traffic management of the City of Harare ranged from improved smooth flow of traffic and reduced delays in movement of goods, services and people to their respective destinations. Other explanations included real time reporting method to the traffic information centre, integration of traffic activities across transport modes and improved insights to assist in enforcement.

When asked on who should advocate for the ITS to the stakeholders, the executive respondents, 80% suggested the use of the city of Harare public relations department, 15% suggested the City traffic department and the remainder suggested a collaborative effort by all the city executive staff.

Below is a visual depiction of the perceptions of the executive as to who should own the ITS system, 75 % expressed that it should be owned by the City council whist 17% suggested that it should be public private partnerships and the remainder did not respond to this question. This shows that even though the city fathers show an interest in an ITS, they also demonstrated their understanding of the need to retain control due to the sensitive nature of the data that an ITS system can generate and record which the executive members

feel will be safer in the hands of the city council and not in a third party who may do unethical conducts for example selling the data to increase their profit margins or breach privacy by collecting intrusive personal information of motorists and pedestrians.

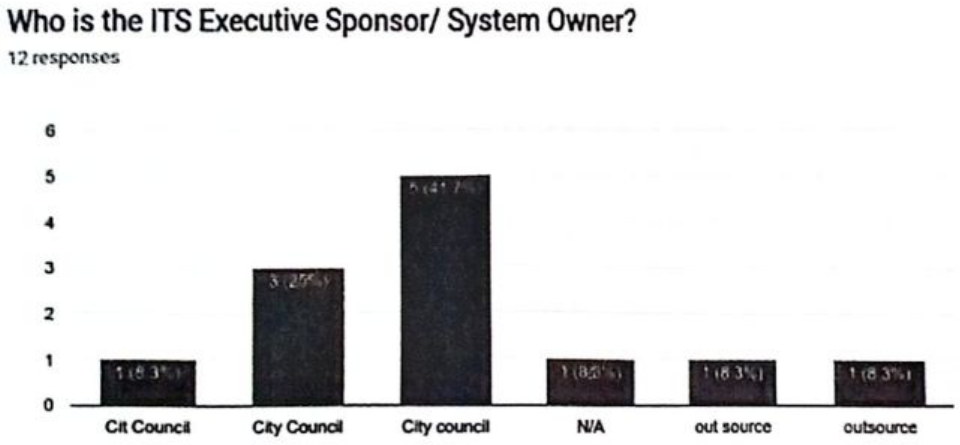


Fig 5.4: Proposed System Owner

5.4.2 How should the concept sold to the senior leadership?

The city of Harare executive respondents suggested collaborative and engagement, training and being shown how other developed cities are managing their traffic management as means of getting decision makers within the city council to buy in to the implementation of ITS.

This ties in closely with the notion that despite, 66 percent of the city of Harare having a 2025 vision having an ITS component but conversely 50percent of the sample acknowledging them not having an ITS project implementation plan. Without adequate buy-in from the decision makers the ITS component of the 2025 world class city will die a natural dead out of neglect and might be underestimated due to management not knowing the impacts and ITS might have on improving the city's residents and visitors a better standard of living.

5.4.3 Who formulated the ITS, Project Plan?

Based on the results of the study, 85 percent of the respondents reported that the traffic management department was the one responsible for formulating the ITS plan and upon further introspection as to who constitutes the ITS team it was observed that the same Traffic Management Department constitutes the bulk of them thereby creation of information silos and lack of diversity and

collaborative effort by other departments which could make a positive contribution to the ITS project implementation.

5.4.4 Assessment of ITS capacity

- **Realised Capacity**

The city of Harare has a fleet of vehicles for patrols; car lifting and towing equipment manned by drivers and trained operators for enforcement of road traffic regulations and proper parking of vehicles within the city. For the later, the city council has contracted easy park to control parking lots in the Harare central business district among other busy areas and Easy Park uses road surface mounted sensors to detect vacant and occupied parking spots.

- **Underutilised/ Unutilised Capacity**

In the city of Harare, especially in the central business district there is a complex network of fibre optic cables installed by most if not all of the internet service providers connecting their offices or customers.

That sometimes trifle with road and water networks as evidenced by some installations running aside water and sewer pipes or necessitating tarred roads to be drilled for installations to continue. These networks are not being used by the City of Harare to provide a backbone to a real time ITS solution that will inform the city of Harare's transport department of the current state of traffic at any given moment through relaying road sensor information.

- **Distribution of business units within Harare City Council**

Size and distribution play an important role in the way the resources are optimised. Size has a bearing on the ability of an organization to manage change, promote learning and collaboration within the departments. To have a feel of how the business units are distributed along the clusters (Executive Head Office, Administration Management and Operations) a stacked bar chart was constructed in SPSS.

5.4.5 Document Analysis

From the Meta analysis conducted on the city of Harare's official documents, the following findings were unearthed and summarised in table 5.1 below.

Table 5.1: Showing Document Analysis

Document Type	Key Finding/s
External Facilitator Contract and Correspondence	• No contract found in the file • No written communication
The City Council Project Plan	• No documented ITS objectives • No ITS Project Plan • No documented communication strategy or plan • No formal project evaluation report
The ITS Training Programme	• No written down ITS Training Programme showing training objectives, curriculum, training content or training lesson plan • No formal formative and summative evaluation reports.
The City council ITS Strategic Document plan	• Corporate Strategy Document • Business Cluster ten year (2015 – 2025) strategic initiatives available but with little emphasis on ITS. See Appendix IV – Logistics 5 year plan.

Sources: Authors' Survey (2020)

Outcomes of Participant-Observations

From the participant-observations conducted during the course of this study, the key or notable metrics for assessing effectiveness and efficiency of Harare city council were captured and are tabulated below.

Session Observed	Salient Features / Excerpts
Weekly Executive Committee Meetings	• No formal agenda for ITS in the meeting – the chairperson decides focus of each meeting. • No formal minutes – members jot down notes and action points in their notebooks. • Some matters arising not being followed up in the next meetings • Limited cross functional interactions, members focus mainly on their business units performance • Chairperson dominates the discussions • Major focus is on financial performance measures • Emphasis is on presentation to the Mayor and the Minister of Local government. • "I need the storyline for the Board and the revenue collected from traffic offences and City park" frequent statement by the chairperson.
The City council Strategic Planning and Review Sessions	• Executive members focus on presenting key initiatives for their respective department. • Limited interaction among team members during the sessions • Interrogation of the financial numbers mainly by the Chairperson and the Chief Finance officer. • Team members justifying and defending their financial number. • No ITS format followed during planning and review sessions.

Table 5.2: Key Outcomes from Participant - Observations

Fig 5.5: Police using spikes and sting to stop motor vehicles.
Source: Owner's photograph

The researchers also observed that the current methods of enforcement include: manned roadblocks and police patrols in CBD, spikes & sting operations. These methods of enforcement have also caused further problems such as corruption, delays, creation of artificial congestion, accidents, loss of lives by pedestrians due to them being run over by vehicles evading arrest, the police being injured in the process.

5.5 Discussion

Full understanding and appreciation of the rationale why ITS can be within the city of Harare is important as this helps the employees, stakeholders to accept the new initiative, have total buy-in and be committed to the implementation process. It is therefore important to have all employees and stakeholders (motorist, bikers, cyclist pedestrian) at all levels of the organisation and city to fully understand and appreciate why the ITS adoption should be implemented. The adoption of ITS can be achieved by educating and training employees on the use and application of ITS and how to implement it effectively (Kaplan & Norton, 1996; Niven, 2002; Molleman, 2007). Top management must clearly communicate the objectives of the adoption of ITS, stating the compelling reasons why it should be adopted by painting a picture of how the City will look like when the ITS has been adopted effectively.

However, the research findings revealed that there was no proper training conducted on the adoption of ITS before it is introduced within the City. This was confirmed by the lack of documents on the ITS training programme showing the training content, dates, participants or evaluation of the effectiveness of the training. Therefore, there is no common understanding as to why the ITS approach can be adopted. This lack of common understanding results in confusion and affects the effectiveness of the adoption. The major concern in the findings is that even the executives do not fully understand and appreciate the main reason why the ITS adoption can be implemented and its main purpose.

There are critical success factors for implementing any change initiative including the adoption of ITS in developing Cities. These success factors

include senior management support, effective communication of the change initiative (its objectives and the desired outcomes), thorough understanding of the actual implementation process and an effective evaluation (Hayes, 2010; Kanter, 1999; Kotter, 1995, Kaplan, 2010, Kaplan & Norton, 1996, 2001).

The findings show that non-executive employees perceive senior management as fully supporting the ITS adoption yet of the executives are citing lack of top management support as one of the challenges being experienced in the adoption. Observations during the executive meetings show that the ITS adoption is not followed nor even mentioned at all. This confirms the fact that the ITS are viewed just as an individual or a small and not for strategy communication and execution. An analysis of the documents shows that there is nothing formalised hence it would be difficult to ascertain commitment of top management to the ITS adoption.

A critical analysis of the challenges being experienced in the adoption of ITS in Harare City Centre shows that the challenges basically hinge on two factors; lack of administrative support, financial capacity and lack of understanding of the ITS concept itself and how to implement it. Due to these factors there so many challenges being experienced yet there is nothing being done to address them. The majority of executives and non-executive employees suggested for training or retraining as it is difficult to take any meaningful action by lower employees if there is no top management support and through the knowledge gaps that are not addressed.

5.6 Conclusion

To enhance the knowledge, practices and attitude on ITS in a developing city like Harare and to improve the current state and level of adoption of ITS in developing cities the top management must formulate pragmatic ITS objectives after taking the time to develop a strategy map and the corporate scorecard for City Council. Within this context, the authors conclude that the Harare City Council transport budget is limited, it is essential that the city learn from other developed world like Europe particularly in order to implement ITS as efficiently as possible. The authors further concluded that ITS conceptual plan needs to be developed and formulated. This provides the

blueprintfor ITS development in the city, thus providing the "holistic picture" for allinvolved. It will provide a comprehensive direction of the priorities and what is to be achieved.

References

Angin, P. Bhargava, B & Helal, S. (2010). A mobile-cloud collaborative traffic lights detector for blind navigation.

Eleventh International Conference on Mobile Data. http://xplorestaging.ieee.org/ielx5/5488976/5489227/05489736.pdf?arnumber=5489736

Araghi, S., Khosravi, A. & Creighton, D. (2015). A review on computational intelligence methods for controlling traffic signal timing. Expert Systems with Applications: An International Journal, 42(3),1538–1550. https://doi.org/10.1016/j.eswa.2014.09.003

Balaji, P. G. and Srinivasan, G (2011). Type-2 fuzzy logic based urban traffic management. Engineering Applications of Artificial Intelligence 24(1),12-22. DOI: 10.1016/j.engappai.2010.08.007

Barcelo, J, Gillieron, F. Linares, M.P. Serch, O. Montero, L. ***(2012),*** Exploring link covering and node covering formulations of detection layout problem. Transportation Research Record Journal of the Transportation Research Board 2038:17-26

Chikutukutu, I. (2017). Modelling signalised intersections' capacity Under the impact of varying driver behaviour on transportation Facilities operational performance. A thesis submitted to the University of Zimbabwe.

Economic and Social Commission for Latin America and the Caribbean (2013). Economic Commission for Latin America and the Caribbean (ECLAC) : biennial report (2010-2011). Santiago: UN, ECLAC, 2013

Kumar, N.(2013). Trade, capital flows and the balance of payments. Development Paper 1303. United Nations Economic and Social

Commission for Asia and the Pacific (ESCAP) South and South-West Asia Office.

Eriksson, G., Svenson, O., & Eriksson, L. (2013). The time saving bias: Judgements, cognition and perception. Judgment and Decision Making, 8, 492-497.

Ezell, S. (2010) *Intelligent Transportation Systems.* Information Technology and Innovation Foundation.
www.itif.org/files/2010-1-27-ITS_Leadership.pdf

Ezell, S. (2009). Explaining international leadership in contactless Mobile payments. Information Technology and Innovation Foundation, November 17, 2009. http://www.itif.org/files/2009-mobile-payments.pdf.

Ezell, S. (2017). *Intelligent Transportation Systems.* Retrieved from https://www.itif.org/files/2010-1-27-ITS_Leadership.pdf

Gyamfi, A. (2005). Closing the digital divide in Sub-Saharan Africa: meeting the challenges of the information age. Information Development, 21(1),22–30.

Hayes, D. (2010). The seductive charms of a cross-curricular approach. Education 3-13, International Journal of Primary, Elementary and Early Years Education, 38(4):381-387.,
DOI: 10.1080/03004270903519238

Hull, C. Yu-Ting, H. & Neil, H. (2006). Digital entrepreneurship. EDGE. Accessed from https://scholarworks.rit.edu/article/570 Intelligent Transportation Society of America, (America, I. T.) (2010).

Retrieved from Intelligent Transportation Society of America.

Kanter, R. M. (1999). The enduring skills of change leaders. Leader to Leader 13 (Summer 1999). (Reprinted in Ivey Business Journal, May-June 2000, pp. 1-6.).

Kaplan, R. S. (2010). Conceptual foundations of the balanced scorecard. SSRN Electronic Journal 3:1253-1269. DOI: 10.1016/S1751-3243(07)03003-9

Kaplan, R. S & Norton, D.P. (1996). Strategic learning: The balanced scorecard. *Strategy & Leadership,* 24(5),18-24.

Kaplan, R. S. & Norton, D.P. (2001). The strategy-focused organization. Strategy & Leadership, 29(3), https://doi.org/10.1108/sl.2001.26129cab.002

Kotter, J.B. (1995). Leading change: Why transformation efforts fail. Harvard Business Review, 73,59-66

Levine, J., Grengs, J. Shen, Q & Shen, Q (2010). Intermetropolitan comparison of transportation accessibility: Sorting out mobility and proximity in San Francisco and Washington, DC. *Journal of Planning Education and Research,* 29(4), 427-443.

Mohan, D. (2008). Electronic waste management in Ghana. Thesis submitted to the Department of Civil Engineering, Institute of Technology, Accra, Ghana, pp 3 & 40-60.

Molleman, B. (2007). The challenge of implementing the balanced scorecard. The proceedings of the 6th Twente Student Conference on IT, Enschede, 2nd February 2007.

Niven,P. R. (2002). Balanced scorecard step-by-step – Maximizing performance and maintaining results. New York: John Wiley & Sons Inc.

Prabha, C., Connaway, L.S. Olszewski, L, & Jenkins, L.R. (2007). What is enough? Satisficing information needs. Journal of Documentation 63(1):74-89 DOI: 10.1108/00220410710723894

Rowley, J. (2002). Using case studies in research. Management Research News, 25, 16- 27.
http://dx.doi.org/10.1108/01409170210782990

Singh, B. & Gupta, A. (2015). Recent Trends in Intelligent Transportation Systems. *A Review. Journal of Transport Literature,* 2(30), 9. https://doi.org/10.1590/2238-1031.jtl.v9n2a6

Singh, N. & Gupta, K. (2013). *Environmental attitude and ecological behaviour of Indian consumers, Social Responsibility Journal, 9(1), 4-18.*

Singh, G.G., Tam, J, Sisk, T. D, et al (2014). A more social science: barriers and incentives for scientists engaging in policy. *Front Ecol Environ* 12: 161–66.

Singh S.K. (2017). State *transport undertakings in India:* Status and issues, International Journal of Applied Business and Economic Research, 15(SI): 279-297.

Srinivasan, D. Choy, M.C. & Cheu R. (2006). Neural networks for real- Time traffic signal control, IEEE Transactions on Intelligent Transportation Systems, 7 (2006) 261-272.

Taylor, S. (1997. Empowerment or Degradation? Total Quality Management and the Service sector in R. K. Brown, (ed.), The Changing Shape of Work, London: MacMillan.

Wamboye, E. T. Tochkov, K. & Sergi, B, S, (2015). Technology Adoption and growth in sub-Saharan African countries. Comparative Economic Studies, vol. 57(1), pages 136-167.

RePEc:pal:compes:v:57:y:2015:i:1:p:136-167

Watson, V. (2014). African urban fantasies: dreams or nightmares? Environment and Urbanization 26(1), 35–56.