

ORIGINAL ARTICLES

Traffic Safety for Bus Rapid Transit Mode, Case Study: Tripoli-Libya

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ABSTRACT

This study reviews the Public Transportation (PT) Systems and the opportunities and requirements applied in Libya. Beginning with the definition of public transport systems and their functions and areas of applied and advanced systems for public transport and advanced systems for traffic management, systems and operations of transport vehicles and advanced systems to control private vehicle and safety, with a discussion of the importance of each of them, this paper discusses the requirements of the application of Bus Rapid Transit (BRT) systems in mass with focus placed on the importance of developing an outline plan for the public transport systems. The concept master plan and the options available in Tripoli shall be discussed to develop its map of structural public transportation systems and recommend consideration of the possible adoption of a map structure developed in the advanced countries and some developing countries in this area, with their adaptations depending on the circumstances of Tripoli. It also concludes with the need to establish a permanent institution representing the parties involved, including the public sectors, academia; and vested in the institutions responsible for managing, directing, and the preparation of a strategic plan for public transport systems, including the development of the master plan for those systems. The study recommends starting with pilot projects carefully selected by an explanatory expansion in the application.

Key words: public transport system, bus rapid transit, safety, control private vehicles, traffic management, Tripoli.

Introduction

The use of modern Bus Rapid Transit (BRT) will contribute to solving the problem of the transport crisis in the Tripoli city and lead to a reduction of traffic congestion and preserve the clean environment. In this study, we have put forward different views based on practical experiences learned from other developing and even advanced countries in this area and to shed light on the use of buses as a means of public transport system, other than to ensure the best global safety standards for the buses companies will be created in Tripoli for the next twenty years between 2011 to 2030. Using the latest technology in this area, smart transport systems adopting cutting-edge technologies and applications that are used in today's world, this study addresses the continuous improvement of the safety of public buses and performance management in all road networks of Tripoli city, with reference to the experiences of some countries- developing and advanced- and how to benefit from these experiences. The adoption of this system in the advanced countries was also noticeable in the late nineties, to reduce congestion in cities and this study will study how such system can be manipulated to be in line with the users and situations in Tripoli. Some of the main uses of the system include assessing the status of the road (vehicle safety and number of road users), providing information and managing the movement of heavy transport vehicles. This new system is seen to ensure road safety, reduce travel time, parking, promote the development of research management, smoothen the traffic and even helps in the weather forecasts.

Bus Rapid Transit Applied in Some Developed and Developing Countries:

The current transportation system in Tripoli city, Libya requires significant re-establishment of the public transportation system. One of these public services is Bus Rapid Transit (BRT). The services of BRT provide Light Rail Transit and bus services combining values such as flexibility and efficiency services. The core of bus rapid transit establishment in Tripoli is to reduce the private vehicles namely private-owned car, taxis, minibuses and coaches usage and encourage public transport system ridership with increased service levels. In recent years, there were many cities in developing and developed countries using the bus rapid transit which sought to reduce traffic congestion and provide suitable travel services. Bus rapid transit is defined as a public

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transit mode that different types of buses to provide high quality services such as flexibility, comfort, cleaner, rapid trips and low fare. Bus Rapid Transit can operate with exclusive rights given to the company to deliver services to the urban inhabitants and road user.

(Lead and Bertini, 2009) have made an exploration in their study titled 'Bus Rapid Transit: An Alternative for developing Countries'. Many important advantages of Bus Rapid Transit (BRT) system in Bogota, the capital city of Colombia have been established such as rapid boarding, clean vehicles, comfortable station and terminal, fast and efficient fare, effective regulation for bus operation, integration with other modes of transportation and good customer service. Also the study shows the many benefits after the (BRT) implementation for example the travel time is able to be shortened, also the fact that the pollution gets to be reduced.

(Naoko Matsumoto, 2005) in his study introduces the analysis of policy processes to introduce Bus Rapid Transit system in Asian cities from the perspectives major cities like Jakarta, Seoul, and Beijing. The core of study lies in uncovering the reason why the service of the bus rapid transit in Asia was accelerated in 2004. This study also examines some important figures behind this project and their roles, also what factors had motivated those persons to initiate BRT. The results include the process for Bus Rapid Transit introduced in three Asian cities namely Jakarta, Seoul and Beijing being compared to the service being introduced in Latin America cities like Curitiba and Bogota. The infrastructure cost of BRT system have also been found to far less than that of the rail-based system.

(Hess and Bitterman, 2008) in their study "Bus Rapid Transit Identity: An Overview of Current "Branding "Practice" aims to support the notion of increasing the demand for public transport systems by enhancing and improving high quality services. They mention the use of the BRT system, which provides faster, more comfortable and more suitable travel service. Their study results lead them to argue that the desired increase in public transport transit ridership and ultimate success of bus rapid transit system depend on practical consideration of travelers themselves with regards to the BRT system and its arrangements.

Another survey is designed by (Cervero, *et al.*, 2009) called "Direct Ridership Model of Bus Rapid Transit in Los Angeles County". In this survey, data is collected from 69 mixed traffic operation of the bus rapid transit stops. Results show that the high level service of intermodal connection can be an advantage to the BRT system usage. Surrounding population densities which peruse the BRT service, also employment densities are important contributors to ridership and these factors have further encouraged switching.

Definition of Public Transportation System:

Emerged recently, the "mass transit systems" have been previously known either as "Public Transport (PT) systems of the vehicle and the road (Vehicle-Highway System) in the United States of America, or "Information Technology for Road Transport" (ITR) or "advanced techniques information and communication technologies in transport in Europe, and sometimes are called by both in Japan (Shibata, *et al.*, 1997). It is established that these public transportation systems make use of computer technologies, electronics, communications and control to meet the many challenges facing the land transport, such as the challenge of improving levels of safety, productivity and reducing the travel time and general movement, in spite of worsening traffic congestion and the continuing threats of the safety of transport workers and increasing scarcity in the budgets of agencies responsible for transport (ITS America web site). Public transport systems are the natural evolution of the transport infrastructure although they are constantly updated to keep pace with the information age and the more hectic lifestyle of the mass. This is important largely because as the demand for transport continues increasing, as is the case in Tripoli, the public transportation systems will help to provide greater capacity and energy more efficiently with total reliance on the establishment of new public transport system facilities like the Bus Rapid Transit (BRT) and Light rail transit (LRT). In fact, studies show that the combination of public transport systems and new construction is able to accommodate future traffic growth rates (US DOT ITS web site). The main objectives of the public Transportation Systems (US DOT, National ITS Architecture 1997) are outlined below:

1. Increase the operational efficiency of the transport system and its capacity.
2. Improve the levels of traffic and reduce travel time.
3. Improve the level of traffic safety.
4. Reduce energy consumption and reduce environmental impacts.

Jobs And Public Transport System And Their Applications:

Public transport systems are classified into three categories:

Advanced Systems for Traffic Management:

These systems employ innovative technologies that integrate existing systems and new traffic management and control systems in order to be responsive to changing traffic conditions. The advanced systems for traffic management, "smart way", which are at par with "bus rapid transit", serve as the foundation upon which all other techniques for intelligent transport systems rest (Shibata, *et al.*, 1997).

Advanced Systems for Transport Information:

The systems are developed for gaining access to information and analysis of information, and displayed to help travellers to move from the resident places to the destination they want to go. These systems provide the best way to help achieve the needs of travellers in terms of safety, efficiency and comfort (IVHS America, 1992).

Advanced Systems for Vehicle Control and Safety:

Gathering systems have been developed to control the vehicle, and safety between sensors, computers and control systems in vehicles and infrastructures in order to warn drivers and help them or to intervene in the task of leadership for them. The purpose of these systems include to achieve the highest levels of safety of the vehicle and achieve better levels of productivity of the roads in Tripoli and between other cities, which lead to the creation of innovative concepts for transport services (Caltrans, 1996). In general, applications are advanced for vehicle control and safety within the following general categories of service users:

Longitudinal Collision Avoidance:

This includes sensing the potential collisions and improving the performance of the driver to avoid collision and the vehicle control temporarily to help reduce injuries and fatalities. It also includes sensors fixed both in front and behind the vehicles.

To Avoid Accidental Collision:

This category involves accidental collision with vehicles that leave the lanes of traffic. The technology will help to avoid such unfortunate incidences or to reduce the number of collisions by giving warnings of crash when you change from one lane to another, when the blind spots are near the vehicle, or when you leave the edge of the road, and have to control the vehicle in such cases.

Warning of Collisions at Intersections and Control:

These services allow avoiding the collision at the intersections, where accidents can take place, due to the lack of public transport systems.

To Improve Vision in Order to Avoid Collision:

This service is used to improve the ability of the driver to see objects that are on the road and anything within sight. This service involves the existence of devices on the back of the vehicle to detect hazards (such as fog and dust) and to address these and display information for drivers to take advantage of them.

Readiness of Safety (Warning Disabilities):

It also provides a warning about the state of the driver and the vehicle, and the infrastructure provided along the road. The devices are mounted inside the vehicle for damage control and within the driver's reach without interference, and it provides a warning to the driver against drowsiness or other conditions that hamper safety.

Automation of Vehicles (or the Way Automated System):

The integration of control functions and longitudinal spin-off will allow the vehicle to achieve the mechanism, which functions to stay in the lane and maintain a safe distance from other vehicles nearby. To consider that the public transportation systems are composed of six independent functions, as explained above, it helps to understand the key components of public transport systems, but in reality, the system of public transport systems can be much greater than the sum of its parts, it must from the outset as public transportation systems

group potential of integrated, end is the presence of road transport system and an integrated multi-media public service.

Application Requirements System In Tripoli:

The application of public transport systems cannot succeed only at the public level but also through the establishment of a unified national structural map. The map of the structural framework is common to run exchange for public transportation systems, which is known as the following:

1. Functions relating to services for users of public transportation systems (logical structural map).
2. Natural components or subsystems that perform those functions (structural map natural).
3. Communication requirements associated with the flow of information.

That is, they describe how system components interact with each other and work together to achieve the goals of the college system, as it describes the operations of the system, and the role played by each of its elements, and what information is traded between its components (Caskey and Heermann, 1995). This master plan is the framework through which the development of various services, public transports systems and functions. The general framework of the system based on the objectives or requirements of users needs to be defined. The map highlights the structural sub-systems necessary, the definition of functions to be performed by each subsystem, and to distinguish data that must flow between these sub-systems, thus providing a rationale for the design of the system. More importantly, the structural map of the system as the basis for the development of specifications and methods are needed for the exchange of information between those subsystems. Additionally, a map of the structural system is different from the design of the system. Within the structure of the map, you can perform different designs. Systems, devices and voice recorders can bring a good example of the importance of developing the structural map. Consumers or users determine what are the possibilities that would be sought in a voice recorder (for example, a compact disc or cassette tape player, or a large cylinder), depending on cost and performance. Because the Home Audio Recorders industry has developed its map structure, the vendors of those products offer voice recorders components of the sale of each individual as the users would know full well that those components will work as a single compatible system (IVHS America, 1991). It also serves as the main force to analyze the structural map of the system that provides a strategic framework by which to integrate the activities of the various relevant authorities, and it can provide a map of the structural system as a general framework from which the various parties can perform their supposed duties and relevant responsibilities. Like any other map, the structural map shows roads where interactions and the flow of information between the concerned parties take place.

The aim of the development of a structural map of national public transportation systems is to encourage consensus over the mass transport systems at the level of the Libyan market and thus accelerate the progress of the public transport systems and to ensure that investments are allocated in the right place. The intention is to develop the outline plan that is technically sound, which carries the consensus and support for developers and buyers of its products and users alike.

There are three options available to develop the Master Plan for public transportation systems in Tripoli, which are as follow:

1. Developing the structure of a private map of Tripoli to start from the very basic and not referring to any structure of a list of maps in other countries and also not to consider the projects currently in place for those systems in Tripoli.
2. Adopt one of the existing structural maps in developed countries, which is also replicated in their entirety in Tripoli.
3. To adopt and develop one of the existing structural maps in developed countries, but adjusted as needed and adapted to suit specific local conditions in Tripoli.

The first option improves the master plan for the better. When starting documentation as such, it enables developers to customise the master plan according to the needs and the precise requirements of the various parties concerned. Nonetheless, this effort requires large financial investments and it takes a long time. This method may be more appropriate for industrialized countries that have had a strong industrial base for the products of public transport systems. The primary focus of the developed countries in the development of structural maps of the public transportation systems lies on the standardization of products, public transport systems to market their products such as automotive and traffic control devices for public transport systems, but this situation does not apply in Tripoli. In fact, the first option is the method that is already adopted by the United States of America in the development of its map structural nationalism, which has begun the development of such master plan from scratch without making reference even to the results of the previous American research or the experience of other countries in this area (ITS Focus, UK, 1997). In contrast, the second option, the adoption of a structural map in its entirety, is the least expensive option and the fastest in order to develop a master plan for the national public transportation systems. However, most likely the master plan developed in this way will not be able to meet local needs or to provide services required of beneficiaries.

The first logical step to be taken for the development of any map is to identify the structural requirements and functional characterization. Also, often the functional requirements are the same for many countries, but the differences between the countries are more prominent at the level of policies that set priorities and sequence desired to meet different functional requirements of the public transportation systems.

Before the start of the development master plan for the PT system in Tripoli, a plan of a national strategy for public transport systems, known as national vision towards public transport systems is required. The task seeks to achieve the existing conditions, opportunities and challenges, goals and objectives, and services users, and operational plans in the short term, medium-and long- terms. It certainly is not going to be materialised if the development and preparation of the Strategic Plan come from one side alone, in which case the public bodies only, but it must also involve other parties since the early stages of preparing the strategic plan and development. In developed countries, the relevant authorities have recalled the need to coordinate efforts and organize the establishment of professional organizations independent of the bulk of its attention focused on this task (such as the Organization of America (ITS America web site), and European (ERTICO web site), and Japanese (HIDO. 1996 and VERTIS ITS Japan web site). Therefore, it is necessary in Tripoli and all other Libyan cities that a central body is to be responsible for directing this effort. The options available are as follow:

1. The development of a device (a non-profitable one) plays the role of serving as the general framework which can be adopted by all relevant parties. This organisation must be established to coordinate and accelerate the development of advanced technologies in public transportation system, operation and integration, also acceptance in order to make them compatible and solitary.
2. The development of a supreme body to take over this task.
3. Any of the above options are possibly appropriate when the objective is to develop a comprehensive map of the public transportation systems.

Yet, for a developing country such as Libya, it does not have a strong industrial base for the production of public transport systems, so decision makers may look at the possibility of progression in the development of public transportation systems applications in the Tripoli city. In this case, it can be a direct coordination between the parties on each service user of the PT system plans. Some effective methods to begin the implementation of PT system are to run the demonstration pilot projects. We must focus on the techniques of pilot projects where the risk is low, and those which have proven their ability to provide good results and tangible benefits in the short-time frame. We will develop pilot projects and come up with the preparation of a proper analysis of the priorities required for local conditions. The Ministry of Transport and manage a railway adoption and implementation of a limited number of selected very carefully from the pilot projects, which locates almost the entire part of the powers and responsibilities of the Ministries, which would only require little coordination with institutions and other agencies. The pilot projects will help the Ministry or facilitate the device in knowing the potential of public transportation systems and borders and the difficulties of running it through to actually bring it into implementation.

Conclusion and Recommendation:

This study has been aimed at getting familiar with the concept of public transport systems and reviewing the application domain of the systems developed for traffic management, and advanced transportation information systems and also the advanced systems to control vehicle and safety; with a discussion of the importance of each and its relevance to the reality and circumstances of Tripoli city traffic, and concludes that the bus rapid transit vehicles and advanced systems for traffic management are closest to the application and the most feasible for Tripoli at the moment. The emphasis is on the importance of developing an outline plan for the public transport systems, and to consider the option of cloning and the adoption of a structural maps modifiable and adaptable to suit local needs and conditions in Tripoli, even to suit the principles and policies. We also suggest the need to create a permanent supreme or authority to represent all the parties of public transport system, including both sectors of public and private, academic and research development; and is responsible for this device in terms of managing and directing the preparation of a strategic plan for public transport system, including establishing the bus rapid transit, light rail transit systems and development of the master plans for those systems. It also recommends starting the pilot projects carefully selected prior to the expansion in the application of public transportation systems in the Tripoli city.

In short, in order to be able to involve Libya in the world of public transport systems, it is necessary to form a body entrusted with the responsibility of planning and coordinating the work of public transport systems at the national level, with a membership of all parties concerned to carry out the following tasks:

1. Develop and prepare a comprehensive plan for the Public Transportation Systems.
2. Develop and prepare a map of the structure of public Transportation Systems.
3. Develop a mechanism for coordinating the work of public transport systems carried out by all sectors.
4. Form a closer international cooperation, especially with the developed countries to take advantage of the rapid developments taking place in these technologies.

5. Promote the preparatory work of specifications and standardization of Libya.
6. Adopt a comprehensive national strategy for the traffic and transport management system and provide the demand for transport as part of the strategy.
7. Build an effective outreach system for road users.
8. Make the system the solution to national problems and not a fund-raising agenda.
9. Address the problems of the lack of national staffs and the creation of a sustainable training system.
10. Address the problems of weak information systems and research.
11. The establishment of an efficient system of transport planning and traffic forecasting and land use.
12. Create an effective public transportation system namely Bus Rapid Transit at present time and Light Rail Transit in the future as this second stage helps to reduce the travel time of all trips and users of own cars in Tripoli city roads.

Finally, it must take the initiative to promote the use of public transportation systems technologies such as Bus Rapid Transit in public, and work to ensure the compatibility between the various techniques of public transport systems to enter the system with ground transportation in Libya generally, and especially the Tripoli city with the era of Information Technology.

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Appendix A

Purpose	Objective
1. Increase the operational efficiency of the transport system and increase its capacity.	<ul style="list-style-type: none"> • Increase operational efficiency • Increase the speed and reduce downtime • reduce delays at points of transfer between modes of transport • reduce the operating costs of the infrastructure • Increasing the occupancy of private vehicles and increased use of public transport • facilitate the collection of fare public transport. • Reduce operational costs for the transfer of goods and increase productivity.
2. Improving levels of traffic and reduce travel time.	<ul style="list-style-type: none"> • increase opportunities for mobility Profile • reduce the personal costs of the transition. • reduce the journey time and increase reliability and reduce cost • increase the level of safety and personal security • reduce the cost of the movement of goods for shippers • Reduce travel time and cost • Reduce driver fatigue • Maintain the security of the goods • Achieve safety (for example, through follow-up of hazardous materials)
3. Improve the level of traffic safety.	<ul style="list-style-type: none"> • Reduce the number and severity of accidents and costs, and reduce vehicle theft • Reduce the number of deaths • increase the level of personal security

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