Non-economic benefits of standards

Shenzhen Transport Commission, China

Country: China

ISO Member body: Standardization Administration of the People's Republic of China (SAC)

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1 Objectives and organization of this case study

In recent years, the International Organization for Standardization (ISO) has developed the ISO Methodology to assess and quantify the economic benefits of standards. This methodology can also be used to describe and measure non-economic benefits of standards which are benefits for the society and the environment achieved in full or in part through the use of standards.

The key objective of this project is to evaluate the non-economic benefits in bus operations derived from the adoption of the following Shenzhen standards on Intelligent Public Transportation Dispatch System which were used by the Transport Commission of the Shenzhen Municipality:

- SZDB/Z 30-2010, *Intelligent Public Transportation Dispatch System – Vehicle Dispatch Terminal*
- SZDB/Z 35-2011, *Intelligent Public Transportation Dispatch System – Platform Specification*
- SZDB/Z 36-2011, *Intelligent Public Transportation Dispatch System – Communication Protocol*

Through this project, we hope to be able to demonstrate how an assessment study of the non-economic benefits based on the ISO Methodology can be conducted. We also hope that the assessment results will help to further improve the standards system for the Intelligent Transport System in Shenzhen.

The project of the non-economic benefits of standards of the Transport Commission of Shenzhen Municipality was conducted from June to October 2013. It was led by the Standardization Administration of the People's Republic of China (SAC) and the Shenzhen Institute of Standards and Technology (SIST) with guidance from ISO and support of the Transport Commission of Shenzhen Municipality and the Shenzhen Eastern Public Transport Co., Ltd.

2 Introduction

2.1 Introduction to the organization

In 2009, Shenzhen implemented a reform of governmental institutions. The Transport Commission of Shenzhen Municipality was set up on the basis of the Shenzhen Communication Bureau. The Transport Commission is composed of 13 internal services, 3 directly subordinated departments, 10 external agencies and 6 institutions (see the organization chart in **Figure 1)**.

Main responsibilities of the Transport Commission include the management of:

- bus transport in Shenzhen, rail transport, road transport, waterways, airports, logistics and local air control, rail industry
- urban transport planning, construction, management and conservation
- urban traffic flows
- drafting local laws and regulations for the transport sector, formulating policies and implementing them after approval

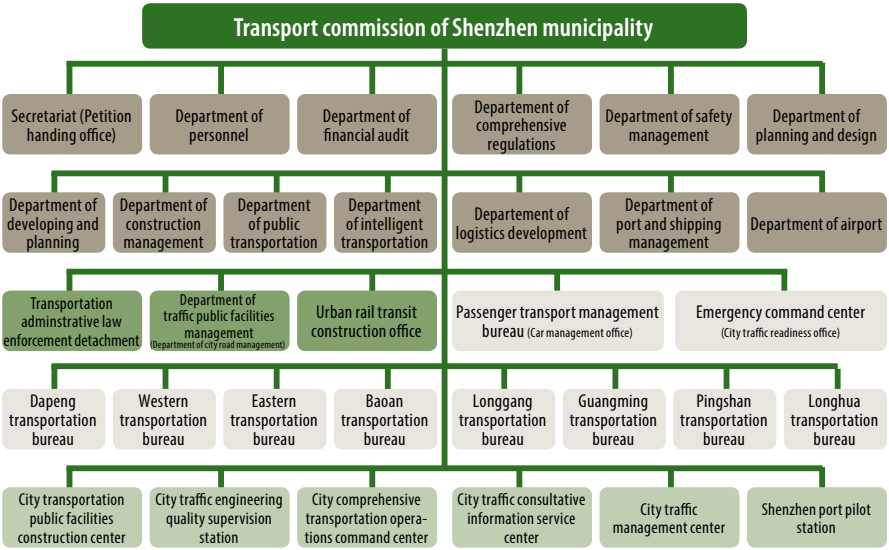


Figure 1 – Organization Chart of the Transport Commission of Shenzhen Municipality

2.2 Selection of an evaluation sample

The services of the Transport Commission cover a wide range in terms of the city's traffic management.

After research and discussions with the leadership of the Transport Commission, and an initial understanding of the effects of standards, we decided to focus on the Intelligent Public Transportation Dispatch System as the sample for this case study. The main reason is that in 2011 the Transport Commission formulated and implemented a series of standards on Intelligent Public Transportation Dispatch System.

The Intelligent Public Transportation Dispatch System adopts advanced technologies to acquire traffic information dynamically. It is an important sign of science-based, modern and intelligent management of public traffic.

Currently there are three bus companies in Shenzhen, namely Shenzhen Bus Group Co., Ltd. and Shenzhen Eastern Public Transport Co., Ltd. and Shenzhen Western Public Transport Co., Ltd. which are under the supervision and management of the Transport Commission. Shenzhen Bus Group Co., Ltd. has completed the Intelligent Public Transportation Dispatch System and has already achieved positive results. The system of Shenzhen Eastern Public Transport Co., Ltd. came into operation on 25 December 2012 and like that of the Shenzhen Eastern Public Transport Co., Ltd., is based on the series of standards of the Intelligent Public Transportation Dispatch System listed in Section 1 of this report.

2.3 Overview of the development of the public bus system of Shenzhen

At the beginning of the reforms in China and the opening up of the country in the late 1970s and early 1980s, the Shenzhen public bus system embarked on a very different path as compared to other large and medium-sized cities in China by applying a market-oriented mode for the operation of the bus system under government guidance. This mode encouraged private investment, and adopted the approach of bids to obtain the authority to operate certain bus lines. Until 2007, the city had 38 bus companies among which most were private enterprises having significantly contributed to the development of the bus service. However, over time the shortcomings of this approach became obvious. These consisted of : a low bus coverage, lack or inadequacy of bus services in remote areas, emerging disorder in areas of large traffic flows, high accident rates, deficient traffic safety and sometimes low service quality. The fundamental reason for this phenomenon is that the market-oriented mode of operation resulted to some degree in a neglect of public demand

for bus services. As a consequence, in the second half of 2007, the Transport Commission reorganized the original 38 bus companies into 3 state-owned enterprises (named *Bus Group, Western Bus Company, Eastern Bus Company*).

Although the integration of 38 bus enterprises into 3 state-owned enterprises greatly facilitated the management of bus transport services by the Transport Commission, the independent operations of three different companies without unified planning and a set of common technical standards resulted in serious problems of interconnection, which were compounded by the use of divergent technologies and products provided by different suppliers and service providers. Without a unified data center and common data platform to monitor and process information concerning bus lines, bus personnel and traffic conditions, the management by the Transport Commission faced with many challenges.

To address this problem, between 2010 and 2011, the Transport Commission developed technical guidelines and a series of standards for the Intelligent Public Transportation Dispatch System, which were implemented in 2011.

The basic intention of the Transport Commission was to use the development of standards to unify the technology and software specifications for intelligent bus systems and to also apply quality standards and specifications for the procurement and operation of hardware.

3 Attitude of the Transport Commission towards standardization

The Transport Commission has been committed to guiding the development of standards for transportation services since its establishment and attaches high importance to standardization. This becomes clear from the following :

1. Establishment of the *Intelligent Transportation Standards Technical Committee*, in March 2010 under the Transport Commission with the responsibility of formulating and revising of standards on intelligent transportation in Shenzhen.

2. Introduction of policies to support the development of standards : "The Twelfth Five Year Plan " on intelligent transportation in Shenzhen clearly put forward the need to accelerate the development of standards for the traffic information infrastructure. The plan focuses on standardization work for hub intelligent infrastructures, video surveillance systems, intelligent urban road facilities, a series of supporting facilities for intelligent buses, terminals for commercial vehicles and the development of other standards for vehicles. It emphasizes the need to improve the working mechanism for standardization, to establish an Intelligent Transportation Standards System compatible with the development of the city's transportation, to finish the formulation and revision of key basic, general and specialized standards, promote the standardization work on the Internet of Things and cloud computing and encourage and guide enterprises, R&D institutes, and colleges to take part in the research on intelligent transportation systems.

3. Formulation of the " Framework for the Standardization system of Shenzhen's Intelligent Transportation Systems ": 2012 saw the approval of :the results of the project, including framework model, hierarchical structure, framework plans, a detailed list

of standards and a statistical analysis chart of standards which could be used as the reference in the guide for the construction of the Shenzhen Intelligent Transportation System. The standards system framework of the Shenzhen Intelligent Transportation Systems contains two parts: general standards and specific standards. General standards are subdivided into: 1. Terminology, abbreviations, symbols and signs; 2. Basic information coding; 3. Digital maps and location; 4. Information security. Specific standards are subdivided into: 1. Intelligent public transport; 2. Intelligent facilities; 3. Intelligent logistics; 4. Integrated transport Operations Command (as shown in **Figure 2**).

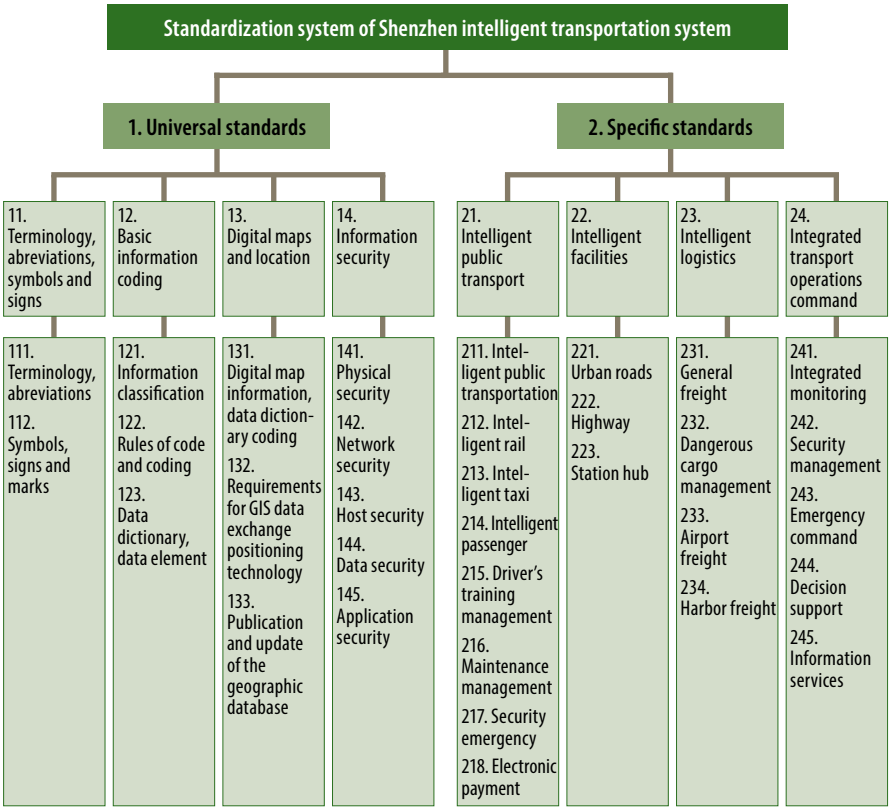


Figure 2 – Standardization System of Shenzhen Intelligent Transportation System

4. Formulation of a number of policy papers on intelligent transportation technologies to guide and regulate the city's traffic-related activities. 14 Shenzhen technical and guidance documents have been published since 2010, covering buses, coaches, heavy trucks, taxis and other.

   The above analysis shows that the Transport Commission attaches great importance to standardization and has done much detailed and basic research. In recent years, the Transport Commission has achieved good results in the standardization work. For these reasons, we selected the Transport Commission as the focus of our study.

4 Analysis of the value chain

4.1 Industry value chain of the Intelligent Public Transportation Dispatch System

The key players in the Intelligent Public Transportation Dispatch System include : equipment providers, system providers, bus companies and traffic management departments. Intelligent Public Transportation Dispatch System mainly includes the following seven main types of activities : Equipment research and development, Production, Procurement, Construction, Operation, Monitoring and Maintenance of equipment. The function of different players in the system and their involvement in the seven types of activities differ significantly. The great coloured boxes in the matrix in **Figure 3** represent the involvement of key players in the value chain of the Intelligent Bus Dispatch System.

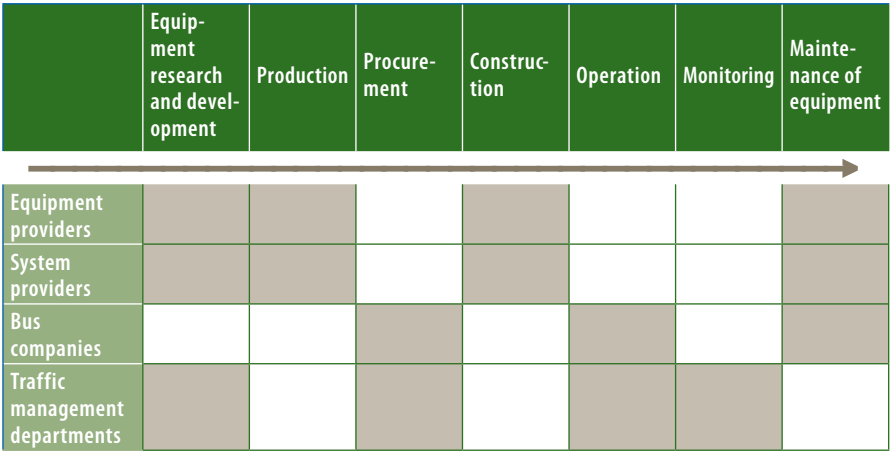


Figure 3 – Intelligent Public Transportation Dispatch industry value chain and involvement of key players

4.2 Core processes in the operations of the Intelligent Public Transportation Dispatch System

The project aimed to evaluate the influence of the use of a series of standards on the Intelligent Public Transportation Dispatch System. The Public Transportation Dispatch mainly relates to operational aspects. From the value chain of the Intelligent Public Transportation Dispatch System, we can see that the main participants in operations are traffic management departments and bus companies. Traffic management departments supervise the bus industry and provide the overall framework for the bus industry. Bus companies responsible for traffic management take part in the daily operations under the authority of the traffic management department. **Figure 4** gives an operation flow chart of the Intelligent Public Transportation Dispatch System. It consists mainly of the following five processes:

- passenger flow analysis
- planning of bus schedules

- real-time scheduling
- operational security
- statistical analysis

which involved personnel, vehicles, stations and bus lines.

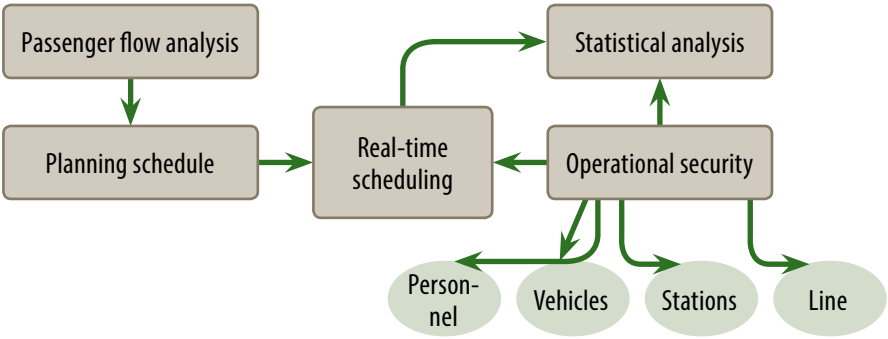


Figure 4 – Operation flow chart of the Intelligent Public Transportation Dispatch System

4.3 Key value drivers

In the ISO methodology, value drivers are defined as the key capabilities of an organization which constitute its competitive advantages. These capabilities include reducing the risks associated with a business, enhancing future business prospects of rapid development, and improving organizational efficiency. From a social perspective, the key value driver in the business of the Transport Commission as a governmental department is its mission in the traffic area with which it is entrusted by the country to promote sustainable development of the society.

Combining organizational management, labor practices, the environment, fair operating practices, consumer issues, community involvement and development, which are concepts derived from "Social Responsibility" as defined in ISO 26000, we can define the

value drivers of the Transport Commission of Shenzhen Municipality as shown in **Table 1.**

Value Drivers	Description
Organizational management	The management of the intelligent Public Transportation Dispatch includes real-time operation dispatching, monitoring, safety management, station management and emergency control.
Consumer issues	One of the targets of the intelligent Public Transportation Dispatch system is to facilitate public travel and provide citizens with a comfortable and satisfactory traffic environment.

Table 1 – Value Drivers

5 Scope of the pilot project

We have chosen the Intelligent Public Transportation Dispatch System of the Transport Commission of Shenzhen Municipality as the scope of this evaluation.

The Intelligent Public Transportation Dispatch includes traffic statistics analysis and the management of planning scheduling, real-time scheduling, operational monitoring, emergencies, query statistics, operational decisions, ticketing payment, operational security and user rights.

6 Use of standards in the pilot organization

Through interviews with the Transport Commission, we learned that the following series of standards are of key importance for the operations of the Intelligent Public Transportation Dispatch system:

- SZDB/Z 30-2010, *Intelligent Public Transportation Dispatch System – Vehicle Dispatch Terminal*
- SZDB/Z 35-2011, *Intelligent Public Transportation Dispatch System – Platform Specification*
- SZDB/Z 36-2011, *Intelligent Public Transportation Dispatch System – Communication protocol*

These standards cover the requirements for the functions and the performance of front-end equipment in the Intelligent Public Transportation Dispatch System, the requirements for the functions and performance of the platform and communication protocol between the platforms. Specific applications are as follows:

SZDB/Z 30-2010 applies to the dispatch terminal of the Intelligent Public Transportation Dispatch system installed on buses in Shenzhen. SZDB/Z 35-2011 applies to the Intelligent Dispatching Platform run by every bus company in Shenzhen. SZDB/Z 36-2011 applies to the communication protocols between the Intelligent Dispatching Platform management and the service platform of the bus industry; between bus terminals and for the exchange of statistical information between platforms; between the Shenzhen bus enterprise management platforms and the bus industry, as well as between the vehicle terminal and data exchange platform. This series of standards has been applied by the Shenzhen Eastern Bus Company in the construction and operation of the Intelligent Public Transportation Dispatch System.

In the course of further analysis, the project team identified that the following standards were used for the individual business functions (see **Table 2)**.

No.	Activities
1	Traffic statistics analysis
2	Planning & scheduling
3	Real-time scheduling
4	Operational monitoring
5	Emergency
6	Query statistics
7	Operational decision
8	Ticket settlement
9	Operational security
10	User rights

Table 2 – Various operations/aspects in which the standards are used

7 Operational indicators to determine the impacts of standards

After analyzing ten activities related to the Intelligent Public Transportation Dispatch System, we identified the following operational indicators to determine the non-economic benefits generated by standards used in the system. In describing these indicators, we indicate how they were before using standards to build the system and how standards have changed them.

No.	Operational indicators	Definition of indicators (to measure the situation before and after the introduction of the standards)
1	Dispatch mode	Degree of automation of the bus dispatches
2	Operation management	Degree and effectiveness of monitoring of operations management of personnel and vehicles
3	Safety monitoring	Degree and effectiveness of monitoring of the safety of the bus operations

No.	Operational indicators	Definition of indicators (to measure the situation before and after the introduction of the standards)
4	Operational guarantee	Reliability of operations of the bus service
5	Operation condition	Degree and effectiveness of monitoring of the conditions of the busses in operation
6	Regulatory indicators	Uniformity of the indicators stipulated by the Transport Commission
7	Emergency response	Timeliness and effectiveness of emergency measures
8	Subsidy payment	Consistency of the conditions under which subsidies are paid to bus companies
9	Decision support	Precision of data in support of decision making
10	Quality of service	Service quality measured through: average waiting time, number of customer complaints and findings from customer surveys

Table 3 – Operational indicators used in the assessment

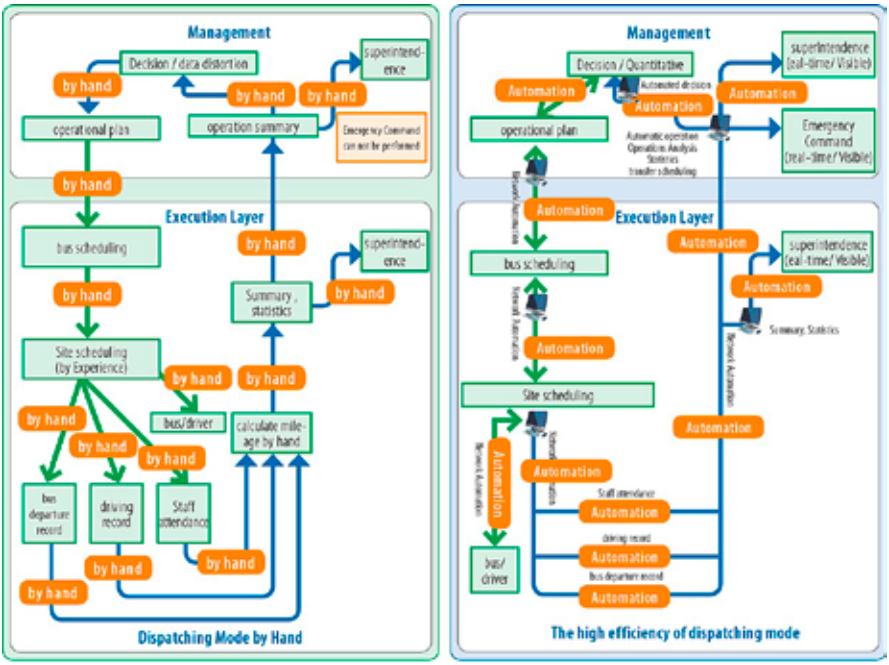
8 Qualitative and quantitative evaluation of the non-economic benefits of standards

The evaluation of non-economic benefits of standards is based on the operational indicators listed in **Table 3.**

8.1 Impacts of standards

The application of this series of standards has contributed to the following outcomes:

Impact 1 : Change in the mode of dispatching busses



Before the completion of the system

After the completion of the system

Figure 5 – Comparison before and after the completion of the system

The above figure shows that before the construction of the Intelligent Dispatching System for Buses on the basis of standards, the system was managed manually based on the experience of scheduling staff : Operational plans, bus scheduling, bus departure records, summary reports, statistics and other aspects were done manually and on-site scheduling was undertaken by experienced dispatchers who had no access to real-time traffic information on the road which forced them to dispatch buses only on the basis of their experience with the changing traffic conditions over the course of a day. As a consequence, there were frequently cases of incorrect decision resulting in low operational efficiency.

Following the construction of a standards-based system, system operation, data aggregation, traffic planning and bus scheduling are automated, traffic data can be aggregated automatically, and on-site dispatching is intelligent and visual, so that a dispatcher can schedule multiple lines in parallel which makes dispatching more efficient.

Impact 2 : Real-time management

Before the construction of a system using standards, the operational management of personnel and buses was often fragmented and highly inconsistent. People were not aware of current conditions and precise location of the buses. Even the number of all the vehicles in operation that could be scheduled was often not known. After completion of the new system, this information is available and vehicles can be scheduled with computer screens to realize the full potential of all available resources. Now dispatchers only manage extraordinary trips, departures, and checking on work attendance, while the system automatically manages regular trips. This allows dispatchers to focus more energy on managing bus departures and to improve the quality of service.

Impact 3 : Remote safety monitoring

Figure 6 – Example of a remote monitoring chart

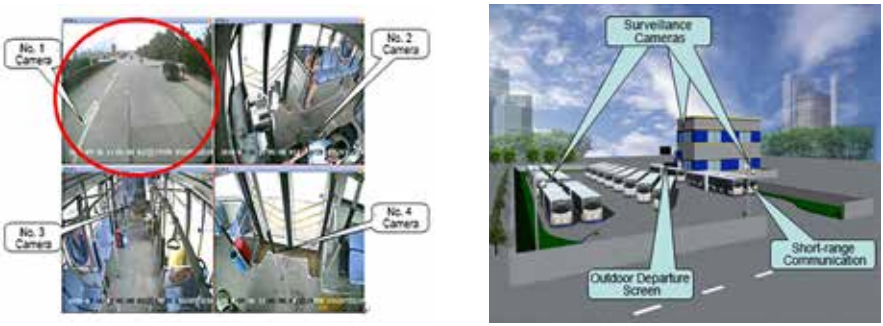
Before the construction of the system, dispatchers did not know the precise operation conditions of the vehicles on the road, for example, whether the vehicles were speeding or violating traffic rules or whether accidents had occurred. Dispatchers can now remotely control the operations of the vehicles from the dispatch platform (see **Figure 6** as an example), because the vehicle terminal sends travel data, station data, and off-station data back to the central platform. When accidents occur, dispatchers can identify the time and the location of the accident, and dispatch another bus to collect the passengers so that their travel is not affected. This has been made possible by remote monitoring.

Impact 4 : Operational guarantee

Operational guarantee refers to making sure personnel, vehicles, stations and lines are available and operational, which could not always be guaranteed before the system was based on standards.

This has changed with the completion of the system and a personnel management system has been established which also includes salary management.

With regard to vehicle protection, a vehicle maintenance and a materials management system have been established. For the bus stations, surveillance cameras, outdoor departure screens and short-range communications were installed to monitor entry and exit of vehicles, publishing departure information etc. (see **Figure 7** as an example). For security, 3G videos are used to monitor road conditions and four cameras are installed in a car. The 1st camera monitors road conditions to determine whether the road is smooth, driver's speed and running through red lights, etc. The 2nd camera with sound pickups monitors the boarding gate at the front of the bus, the coin box and the driver's operation. The 3rd camera monitors the situation inside the bus. The 4th camera monitors the back door (see **Figure 7)**.



Station guarantee Line guarantee

Figure 7 – Surveillance system to ensure operational guarantees

Impact 5 : Visualization of the operations

Before construction of the standards-based system, the Transport Commission could not monitor and survey movement and position of vehicles. Following construction of the system, bus operations can be

followed throughout the day, including the portion of buses in peak operation mode, the punctuality of first and last departures, and can issue warnings for severe speed violations (see **Figure 8** as an example).

The running situation of the whole days

- Total of buses :12 433
- Number of buses in use :11 210
- Number of unused buses : 1 130

Peak usage ratio

- Morning peak : 87 %
- Noon peak : 75 %
- Evening peak : 90 %

Departure punctuality rate of the first and last buses

- Bus group : 95 %
- Eastern bus : 92 %
- Western bus : 98 %

Figure 8 – Summary view of the bus operations

Impact 6 : Unification of data collected for traffic monitoring

Before the implementation of the standards-based Intelligent Dispatching System, data collected by the various bus companies were not uniform. This was evidently not conducive to the management of public transportation by the Transport Commission and for the objective assessment of each of the bus companies. After implementation of the standards, the Transport Commission has unified the data needed and collected by each company, which greatly increases the efficiency of the work of the Commission.

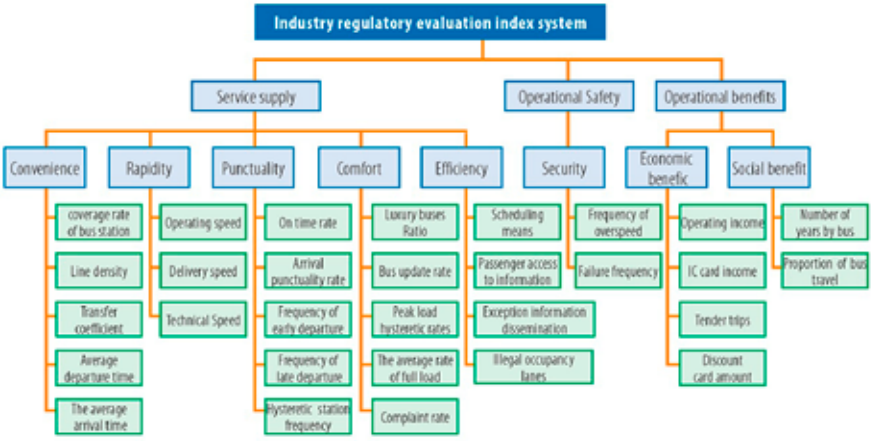


Figure 9 – Indicator system for the evaluation of the performance of bus companies

Impact 7 : Intelligent emergency coordination

When emergency situations occurred in the past, the coordination capability for manpower, capacity allocation and support was relatively weak. After completion of the new system, coordination in emergency situations became smarter, fast and effective through the use of video surveillance, monitoring of commands, contingency plans and other measures (see **Figure 10**).

High-frequency switching video surveillance | Monitoring command system | Contingency plans

Video monitoring, decision support, monitoring command

Figure 10. figure of Bus Emergency Coordination

Impact 8 : Precise subsidy support

Before construction of the system using standards, the Transport Commission of Shenzhen Municipality subsidized each bus in accordance with the cost and running mileage reported by bus companies. This information was often not very accurate, so that subsidies turned out not to be very precise. With the completion of the new system, subsidies are based on calculated mileage from the vehicle terminals thus making subsidies much more accurate.

Impact 9 : Evidence-based decision support

Before implementation of the standards in the Intelligent Dispatching System, decisions taken in the transport sector were often not supported by accurate data, and in many cases were based on personal experience of senior management. Today, decisions are mainly based on data which are collected on bus departure punctuality, arrival interval reports, fulfillment rate of trips and vehicle utilization rates (see **Figure 11**) which allow to plan public transport on the basis of evidence and reliable data.

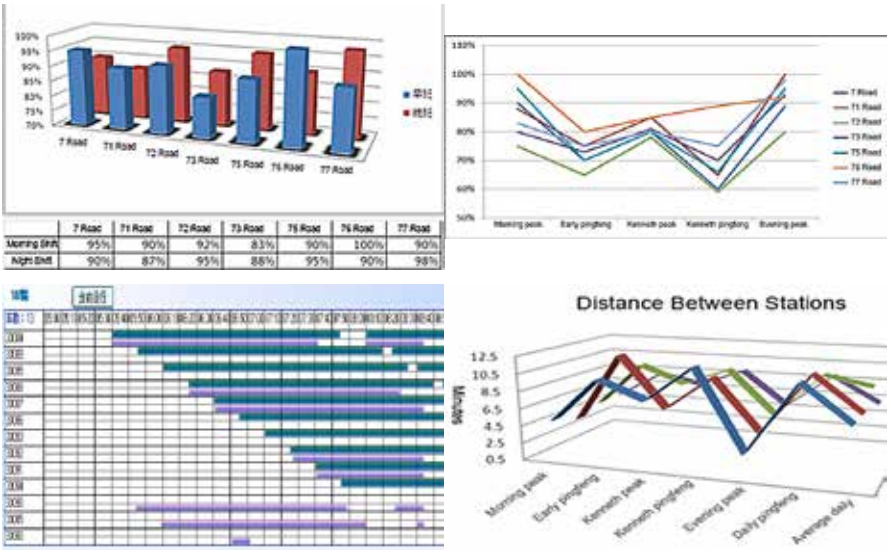


Figure 11. Bus statistical analysis chart

8.2 Quantifying the non-economic benefits of standards

Through interviews with responsible persons of the Transport Commission of Shenzhen Municipality and bus companies, the application of the series of standards used in the Intelligent Public Transportation Dispatch System has a great influence on the operation of buses which can be quantified partially. However, to quantify all the changes in the bus operations, following introduction of the new standards-based system, would be very difficult.

After discussions with the department of the Transport Commission in charge of the buses, we decided to choose Line 398 of the Eastern Bus Company as our sample object to record changes in the key operational data three months before and after the introduction of the new system. To avoid atypical influences due to the holiday period around the Chinese New Year, we chose to analyze the data of July, August and September 2012 and compare it with the data for the same months in 2013. For confidentiality reasons, we only provide the results of the data in this report.

The following is the basic condition of Line 398 : The starting station is Longpu Industrial Area, and the terminal station is Shopping Park with a total of 68 bus stations and 45 buses in operation. **Table 4** gives an overview of the impacts of the new system on the various parts of the bus line :

Assessment aspects	Operational indicators	Quantification of non-economic benefits	Explanation
Operation	Average # of passengers per month	↑ 9.2 %	According to statistical data, before the new system, the average monthly capacity of line 398 was 991 361, afterwards the number reached 1 082 399, an increase of 9.2 %
	Punctuality rate of bus departure	↑ 20 %	The punctuality rate of bus departures increased by 20 % to 30 % because of real-time monitoring of bus operations. In our calculations, we selected the lower value of 20 %
	Speeding violations	↓ 90 %	Due to real-time monitoring, the system emits an alarm sound in case of speed violations which is meant to eliminate the occurrence of speeding
	Time required for the preparation of statistics	↓ 100 %	Statistical data for each bus line is now generated automatically
	Number of staff managing the platform	↓ 60 %	There were 10 dispatchers in 3 shifts before, now only 4 dispatchers are needed, a decrease of 60 % (working efficiency has increased by 60 %). The redundant dispatchers were allocated to other positions
	Average waiting time of passengers	↓ 33 %	According to interviews with the bus companies and the Transport Commission of Shenzhen Municipality, due to the punctuality of departures and even running intervals, the average waiting time of passengers has reduced from 9 to 6 minutes
Service quality	Complaint rate of passengers	↓ 20 %	Statistics of passenger complaints being quite random, we decided not to use the data of Line 398. According to interviews with the bus companies and the Transport Commission, the passenger complaints decreased by 20 % due to the Intelligent Public Transportation Dispatch System
	Convenience of passengers	↑ 50 %	According to interviews with the bus companies and Transport Commission of Shenzhen Municipality, the convenience of passengers has increased between 50 % and 60 %, so we selected the lower rate of 50 %

Table 4 – Changes in the operational indicators resulting from the new system

From **Table 4** it is evident that since introducing the new system, the operation and service quality of the bus services has significantly improved. We have to note that data for some of the operational indicators are based on the experience of the interviewees in their daily work. Another important issue to point out is that these benefits were not only generated by standards, but that there are many other factors that have affected the indicators. Standards are only one of these factors. Through interviews with the developers of these standards, standards users, staff in the department for intelligent public transportation in the Transport Commission, we came to the following conclusions:

1. Factors affecting non-economic benefits of public transportation include: the reliable operation of a bus lane, the bus performance, intelligent dispatching system and other intelligent road facilities. For these factors, the benefits generated by the Intelligent Public Transportation Dispatch System may reach 50%.
2. Factors affecting the Intelligent Public Transportation Dispatch System include: the application of standards, the performance of equipment, the quality of personnel.

Following various reviews and discussions, we believe that the benefits generated by standards may reach around 20%. Therefore we arrived at the following formula for the calculation of non-economic benefits of standards:

Non-economic benefits of standards = Contribution of standards on the bus dispatch system × Standards for the Intelligent Bus Dispatching System.

On the basis of the above factors, we consider that the non-economic benefits generated by the standards for the Intelligent Public Trans-

portation Dispatch System may amount to around 10 % of the total benefits generated by this system (see **Table 5)**.

Assessment aspects	Operational indicators	Quantification of non-economic benefits	Explanation
Operation	Average # of passengers per month	↑ 0.92 %	The average monthly ridership increased by 0.92 %
	Average punctuality of bus departure	↑ 2 %	Punctuality rate of bus departure increased by 2 %
	Speed violations	↓ 9 %	Speeding violations decreased by 9 %
	Time required for the preparation of statistics	↓ 10 %	Save time of statistics decreased by 10 %
	# of staff managing the platform	↓ 6 %	Dispatchers decreased 6 %
Service quality	Average waiting time	↓ 3.3 %	The average waiting time of passengers decreased by 3.3 %
	Passenger complaints rate	↓ 2 %	The complaint rate of passengers decreased by 2 %
	Passenger convenience	↑ 5 %	Convenience of passengers increased by 5 %

Table 5 – Non-economic benefits generated by the use of standards

9 Evaluation of the results

Applying the ISO methodology and through the analysis in Chapter 8, we have determined that through the use of standards on Intelligent Public Transportation Dispatch System, the Transport Commission of Shenzhen Municipality has achieved the following benefits in intelligent bus dispatching:

- efficiency in the dispatch operations
- real-time control operations
- remote safety monitoring
- operational guarantees
- systematic monitoring of key performance indicators
- evidence-based decision and planning support
- increase in the determination of the exact amounts of subsidy payments
- smart coordination of emergency situations

In quantitative terms, the introduction of standards as a basis for the Intelligent Public Transportation Dispatch System, has resulted in the following improvements (assuming that the contribution of standards to improvements resulting from the introduction of the new system is on average 10 %):

- the average monthly number of passengers increased by 0.92 %
- the punctuality rate of bus departures improved by 2 %
- speeding violations decreased by 9 %
- the time needed for preparing statistics decreased by 10 %
- the number of dispatchers reduced by 6 %
- the waiting time for passengers reduced by an average of 0.4 minutes
- passenger complaints decreased by 2 % and passenger convenience was enhanced by 5 %.

10 Conclusions

Applying the ISO methodology to evaluate the non-economic benefits of standards on the Transport Commission of Shenzhen Municipality showed that the use of standards has largely increased the management efficiency of the Transport Commission and that citizen satisfaction has increased to some extent. The assessment of a sample bus line showed that benefits from the application of standards were significant. One can envision the significant benefits that could be generated if other bus lines would follow this example.

We should also note that this is the first time for the Transport Commission of Shenzhen Municipality to conduct this type of assessment. Although the interviewees are certain that non-economic effects have resulted from the standards, some benefits could not be accurately quantified. Many assessments were based on personal views of those individuals who participated in the interviews and only few data have been obtained from statistical or other resources. The consequence of this is that, as some results may be influenced by the personal views of the participants, this study has some limitations.

Annex : Project participants

In addition to the individuals listed on the cover page of this report, the following have participted in this project :

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- **Market Supervision Administration of Shenzhen Municipality (MSA) :**
  - Mr. Tan Jianjun, Division Director, Standardization Division, MSA
  - Mr. Cheng Shengtao, Principal Staff Member, Standardization Division, MSA
- **Transport Commission of Shenzhen Municipality :**
  - Mr. Chen Binli, Director, Intelligent Public Transportation Center
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  - Mr. Huang Jianbin, Catchpole, public transport Department
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