The importance of development processes and control methods for urban bus services

EDUARDO FACCHINI, EDUARDO DIAS
GAESI – Department of Electrical Energy and Automation Engineering at Polytechnic School
University of São Paulo
Av. Prof. Luciano Gualberto, trav. 3, nº 158, ZIP 05508-970, Sao Paulo/SP
BRAZIL
eduardofacchini@usp.br http://www.gaesi.eng.br

Abstract: - This article aims to discuss the importance of developing methodologies and process control by the government for the proper management of the urban bus system. It is a reflection which addresses the idea of management control from the perspective of an operational perspective, strategic and innovative. It proposes a new look for the solution of negative externalities that arise in the urban environment of cities as collisions, pedestrian accidents, works that may obstruct the road bed and various events disrupting local traffic and impacting directly on public transport mobility on tires. The theme is present, it addresses the more urban issues on the agenda of the contemporary world, which is mobility. Thus, the article tells the experience of São Paulo and discussing a new control methodology for urban bus service

Key-Words: - urban mobility, public transport, externalities, operation, control.

1 Introduction

In large cities, there are negative externalities related to urban mobility. Its solution could improve the daily life of citizens.

These externalities arise from vehicles' accidents, traffic congestion and also a lack of urban mobility, caused by factors such as the lack of mass transit, like subways and railway, with high-capacity of transportation.

Another essential factor in urban mobility is the standardization of business hours, with stay on the background of traffic congestion and "peaks" and "rushes". As showed by Foucault (2014), this is the legacy of time. In this scenario, buses and, consequently, their users, are the most affect.

A critical problems of bus service in large cities, such as São Paulo and others, is seen sometimes like simple appearance. However, it is central in studies about urban. The problem is to inform real-time the bus schedule for users, making their experiences better.

The lack of an efficient information system in bus services is often caused by negative externalities, such as traffic congestion, unexpected events etc. Besides that, the frequency of bus services, which is measured in time scales, unlike São Paulo's subway, for example, represent another problem.

This article aims to a conceptual discussion between the model of control used in urban bus service and the desired model. For this purpose, we use the model of São Paulo and analyse the literature of urban mobility. To achieve our objectives, it is done a brief description of current and historical situation of bus service in São Paulo.

São Paulo has faced many kinds of problems, regarding to the public mass transportation on tires and urban bus service. Because of that, it has a great experience. In addition, the case study, called "Operação Controlada" (controlled operation), has been placed there.

2 Experience of São Paulo – A case study

São Paulo has two types of contracted operators: companies with concession contracts and cooperative, in past, of unauthorized vehicles (nicknamed "perueiros", as they had vehicles type called "peruas"), with contract of permission.

The fleet consists of 15.000 vehicles, 10 thousand of concessionaires and five thousand of cooperatives and small businesses licensees. As São Paulo's bus fleet is considered the largest in Latin America, it is a relevant and therefore important to say that, according to Armstrong Wright (1986), "ideal dimension of transport services operators is a

key issue in the discussion on organization of public transport".

In São Paulo, part of the permissionaires operators still bet on growth. Fact that this has generated an endless fight with the government that granted permanent authorization to them and it guarantees that they can provide service to the system. Other permissionaires seek to become a concession contract, such as the others operators.

2.1 São Paulo Transporte S.A. – SPTRANS

The company SPTrans was created to manage the transport system of the city of São Paulo (SPTRANS, 2015).

In 2013, the newly elected mayor decides to create a group of study about procedures for control of the municipal bus system, due to poor performance and failures on schedule. The idea was bring a new concept that could offer and guarantee, for urban public bus system, safety, quality, reliability and comfort, such as the subway system.

2.2 Agreements on bus service system

There are two agreements that allow a private company to offer public bus service in São Paulo:

(1) Concession Agreement - signed with companies operating the services through a bidding process. Each concessionaire is paid by user, regardless of the set fare.

(2) Permission Agreement - signed with operators of small cooperatives and companies. Each permissionaire is paid by user, regardless of the set fare.

For the purpose of this article, we will call as operators both concessionaires and permissionaires. Operators are responsible for many aspects that make up the current system, like:

Supply Fleet and location and communication equipment, both, fixed and embedded;

Provision of infrastructure, that is required for the services, such as garage, workshops and administrative facilities;

Provision of human resources for both, operation and maintenance of the fleet;

Management of Operational Control Fleet in service.

By their side, SPTrans is responsible for contracts and monitoring and inspection of service.

3 Literature

3.1 Bus control in São Paulo

The control is currently exercised by the operators themselves, who receive a work order from the system manager (SPTrans).

In fact, the study group created by the new mayor focuses in understand what actually the government should keep under control. The word control comes from medieval Latin (contra rotulum) and evolve in many languages. Contre-rôle, in French, controle, in Portuguese, control, in English, etc. (GUALAZZI, 1992 apud LUNKES, 2010).

In other words, "control is ensure that everything goes according to the rules and the orders given." (FAYOL, 1981, p. 26).

As mentioned, the control word may have different concepts and different meanings. Chiavenato (2003, p.176) shows three concepts of control:

(i) Control as restrictive and coercive function. Used in order to curb or limit certain undesirable deviations or unacceptable behavior. In this sense, control has a negative character, often interpreted as coercion, demarcation, inhibition and manipulation. It's called social control when applied in organizations and society to inhibit individualism and personal freedom.

(ii) Control as an automatic control system. Used automatically to maintain a constant flow or operating a system. This is the case of the automatic process control of oil refineries, continuous and automatic chemical processing industries. The control mechanism detects possible deviations or irregularities and automatically provides the necessary control to return to normal. When something is under control, it means that it is normal.

(iii) Control as an administrative function. It is the control as part of the administrative process, such as planning, organization and direction.

Lunkes (2010, p.3) in his research on the concept of control, argues that concepts of control converge on a common basis: the comparative analysis between the "ideal and the real". Control is the procedure whereby confrontations are made, against the planned (ideal) and actual (real). This confrontation is made with information about implementation of processes before planned.

In our case, the concept of control for urban bus service fits these concepts, Chiavenato's (2003), and

Lunkes' (2010). When we plan a urban bus line, we make a schedule that we want operator complies, it is the "idealized" part. When the operator provide the service, it is the "real". Our focus must be systemic, we should consider the concepts and research on General Systems Theory.

As mentioned, a transport operation system always aims to achieve a goal of quality and could have (and should have) monitoring and some control, both connected to subsystems within the context of the process of the operation.

According Mosimann and Fisch (1999), system of control can be classified into open or closed (circuit) of control. Closed control is, in some way, like the electrical system of a house, where the basic requirements of service are already pre-calculated and the information is fed back by the system.

On the other hand, open control system means that information produced by the system itself is not sufficient to complete the circuit. The system needs interference from an external component for decision making. This external component, in case of bus service, for example, is an employee of the operator.

There is also a difference between monitoring and control, which is effectively the exercise of control. Monitoring means observation and recording routines for future adjustment when necessary. Monitoring: aims to support managers with simple and timely information about operation and the effects of the program, showed in panels or monitoring indicators systems (Jannuzzi, 2009, p.124).

When we focus perhaps the most difficult of our problems, obstacles that urban bus should win. Theorize away our potential allies, among them the traffic lights. According to Oliveira Neto (2004), isolated traffic lights system is the simplest control system. That is only half true, because we fail to consider the physical space. It is necessary to discuss the democratic distribution of urban space (MORAES; FACCHINI; BOVO, 2014, p. 60).

We must consider all aspects to prioritize bus service in the urban setting, including traffic signal, but the fact that street space is finite should be taken into consideration. The first urban traffic control systems, according to Wood (1993) aimed to improve traffic flow and conditions solely on private vehicles. Over time, these goals were expanding to include, among others, maximizing pedestrian, transport safety, bicycle, as well as reduction of fuel consumption and emissions, improving environmental conditions, and only recently, public transportation.

3.1 Operational system of urban bus

Another relevant element for Operação Controlada is the concept of Urban Bus Operating System: in a simply way, it is a set of elements and or subsystems, which act simultaneously or in a synchronized manner, and always aims to achieve a quality goal and can and should have monitoring and control.

Bus service is always under unexpected events in their pathway (streets and avenues) and this is relevant for modelling a bus control system. Such events impact the service provision, for example, when as accident occur, blocking the street.

Public transportation has some peculiarities, such as intangibility; simultaneity between production and consumption; lack of standardization; high dependence on human factor; irregular demand, and consequently, instability and uniformity in production; great geographic dispersion in non-controllable environment (topography, urban design, traffic congestion etc.); regulated market and generally with differences in service provision; and the context of transportation system and its main actors: users (demand), companies (supply) and the government (regulator) (CRUZ, 1998, p. 46).

Monitoring is used by government to regulate concession and cover different points: practical, technical, financial and legal.

Beyond the concession agreement, it is necessary to monitoring and control the service in practice, because even if the operator do what must be done (according to the needs of the service and the agreement), the service is vulnerable to unexpected or, rather, unforeseen events among its itineraries. The central problem is the lack of organization and methods in inspection process, monitoring and control of the service.

Comparing with other modals, bus services face an adverse environment, with a lack of control.

4 Operação Controlada – the pilot project

In an open control system, such as the transport system, it is essential to establish routines and procedures in order to minimize the risk of unforeseen. It is essential to search elements such as (structured and dynamic) manuals of procedures.

The pilot project of Operação Controlada used the night lines of bus service in São Paulo. As designed, SPTrans (contractor) should command the operation, defining departure time and others settings.

The technology used in São Paulo's transportation system is an equipment installed in vehicles, as the validator for control of the ticket (called Bilhete Único), and other subsystems and support systems. Figure 1 illustrates the set of embedded control equipment.

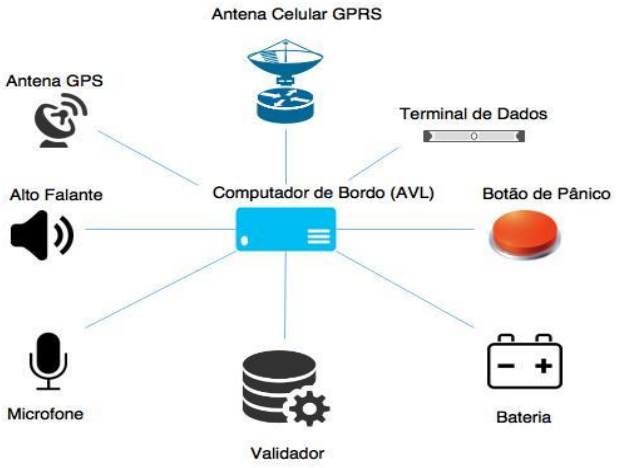

Figure 1. Schematic drawing of embedded equipment of vehicle fleet of São Paulo.

SPTrans started the development of one of these systems in 2002, Info-Trans system, when the company sought improve the outdated applications.

Info-Trans is a system that contains a database with all the information regarding the city's transport network. Itineraries, bus stops and other registers

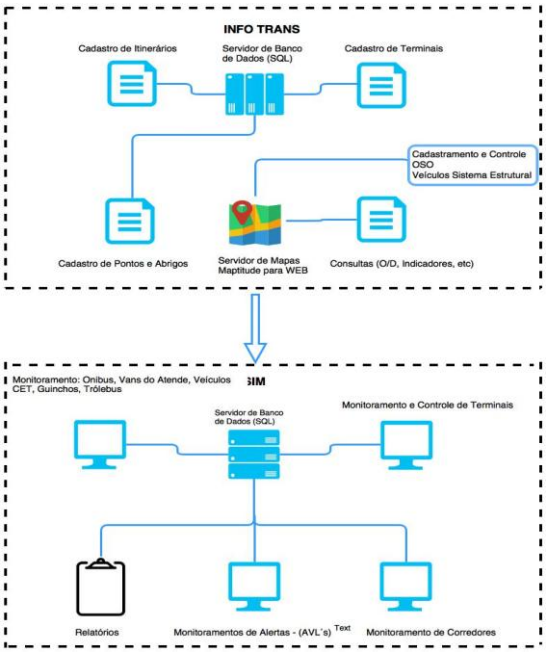

Figure 2. Schematic drawing of the architecture of Systems SPTrans

Operação Controlada puts operators as fleet suppliers and human resources (embedded crew) for operation. Government, in the figure of SPTrans, commands the Operational Control Center (Centro de Controle Operacional – CCO), the operations. SPTrans commands departure and vehicle's march and has the support of the Company of Traffic Engineering (Companhia de Engenharia de Tráfico – CET) for any adverse event on streets.

In departure terminals, minutes before the departure, operators inspect all vehicles. This operation is called IVO (Operacional Vehicle Inspection – Inspeção Veicular Operacional). Operator maintains a support team to check the basic conditions, such as lights, operation of AVL - Automatic Vehicle Location, among other items, and they check if drivers are registered and trained. The cleaning of vehicle is also checked in this inspection.

The Operational Reserve (Reserva Operacional) is vehicles provided by operators that remain available in departure terminals, with a crew prepared to assume in case of any eventuality, when requested by Operational Control Center.

Until end 2012, almost all the technology involved in the transport system was used only for revenue control and monitoring by SPTrans in just a few points. In other hand, the system was controlled only by operators.

The pilot project was conducted during late night hours, not only because it represents a new service offered to the population, but because of the light traffic.

Other premise was to follow the best management practices in order to remedy possible irregularities, and follow pre-defined rules for decision-making. The whole process was also defined and described in a manual of procedures to ensure that each subsystem would work in order to support the decision maker.

Since 2005, SPTrans began to monitor the operation of public transport system on tires with AVL - Automatic Vehicle Location. The equipment inform the geographical position of the vehicle to the manager and system operator using GPS - Global Positioning System and GPRS - General Packet Radio Services

Buses also had other equipment: such as microphone, speaker and a data terminal, that transmits information between operations centers and driver as shown in Figure-1. There are also the Infotrans system and SIM - Integrated Monitoring System, which provides systematic information to the operators and the operations center, as appears in Figure 2.

The old system presented communication errors, as GPS embedded in vehicles works with a local cell phone chip that is sometimes out of range, preventing recognition be satellite. In addition there was also the lack of maintenance in AVL.

Figure 3 presents a functional analysis of the proposed on the pilot project.

The operation begins with the operators presenting their vehicles in the departure terminal, where they pass through an inspection. Then they start operation, when the case, following SPTrans orders and, at last, return to departure terminal

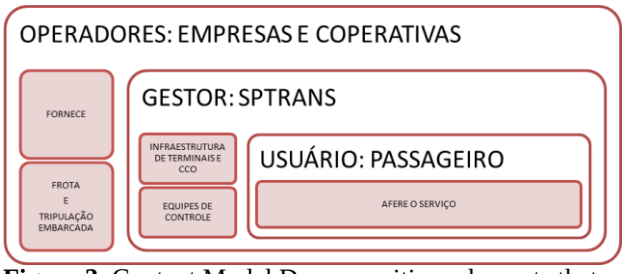

Figure 3. Context Model Decomposition: elements that interact with the system.

The pilot project involved 12 lines, 3 structural and 9 local and their key innovations of Operação Controlada are the control completely in the hands of government (SPTrans) and a vehicle with crew for support at the terminal, called Reserva Operacional.

5 Complaints and user's view - reasons

The user's view should always be taken into account when dealing with public services, because it can show us information that we don't have: the daily experience. The report made by SPTrans in June 2013 draw out some clarifications which was the justification of the pilot project of Operação Controlada.

The user complaints could be solved with in Operação Controlada:

(1) Issues about regularity: excessive interval; noncompliance with scheduled departures, disruption or deliberate delay of the trip, overcrowding buses. These complaints correspond to 45.81% of the total;

(2) Issues about itinerary: driver change the planned route; change the starting point and / or the ending point without SPTrans authorization. These complaints represent 1.48% of the total;

(3) Issues about fleet's conservation: poor vehicle condition, mechanical problems and lack of cleaning. These complaints represent 2.09% of the total.

We conclude that Operação Controlada could reduce at least 49,38% of users complaints, when implanted in the system as a whole. Significant improvement in the quality of services by bus in the city of São Paulo.

Table-2 presents the structure of the pilot project, its structural lines and locations used and operators who attended during the project period.

Table 1. List of structural lines and Sites of Operation Controlled Pilot Project

ESTRUTURAIS		FROTA	OPERADORA
1	TERM JD ÂNGELA - TERM S. AMARO (PASSAGEM T. GUARAPIRANGA)	8	CAMPO BELO
2	TERMINAL PIRITUBA - TERMINAL LAPA	3	STA BRIGIDA
3	TERM. A. E. CARVALHO - TERM. PQ. D. PEDRO II	2	VIP - 3
SUBTOTAL		13	
LOCAIS		FROTA	OPERADORA
1	TERM. JD. ÂNGELA - PARQUE DO LAGO	2	COOPER PAM - 7
2	TERM. JD. ÂNGELA - JD. HORIZONTE AZUL	2	COOPER PAM - 7
3	TERM. JD. ÂNGELA - JD. RIVIERA	2	COOPER PAM - 7
4	TERM. PIRITUBA - CIDADE D'ABRIL 3ª GLEBA	2	STA BRIGIDA
5	TERM. PIRITUBA - JD. DONARIA	2	STA BRIGIDA
6	TERM. PIRITUBA - VILA MIRANTE	1	TRANSCOOPER
7	TERM. A. E. CARVALHO - JD. ROBRU	2	VIP - 3
8	TERM. A. E. CARVALHO - OLIVEIRINHA	3	VIP - 3
9	TERM. A E CARVALHO - VILA CISPER (CPTM USP)	2	TRANSCOOPER
SUBTOTAL		18	
TOTAL DE FROTA NA ETAPA 1		31	

SPTrans took the operation's control and presented good performance. The pilot shown results in departure with no dalay and also a high of regularity in the operation, as Figures 4 and 5.

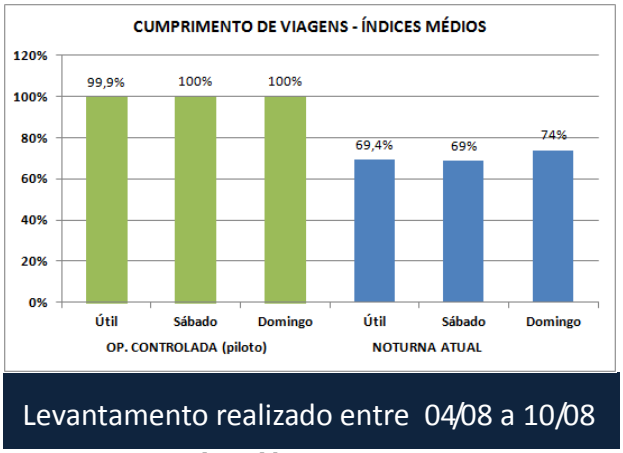

Figure 4. Survey conducted between 04 to 10.08.2015 on time 00.00 04.00

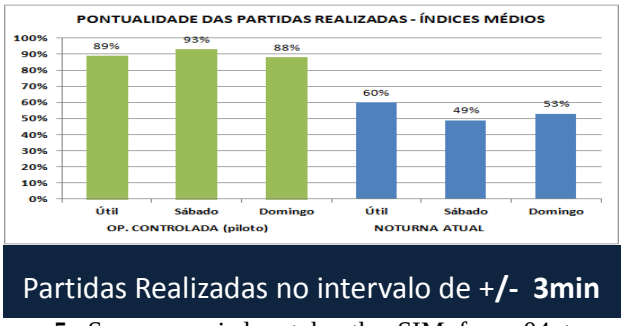

Figure 5. Survey carried out by the SIM from 04 to 10.08.2015 on time 00.00 04.00

It is important to remember that Operação Controlada is expected to reach a better level of performance with the new network, with new routes, that avoid lines overlap and allowing greater range, new points of connection.

6 Results, considerations and contributions

In this case study we presented aspects related to the control of bus operation in the city of São Paulo and the importance of Operação Controlada.

In fact, the service of bus in São Paulo have not presented adequate results and is still not meeting the population desires.

There are two categories of management control, according to Cunningham (1992). One concerns the controls of results or products, the other involves control of people, training of human resources, managers and operators, which may be related to rules, procedures, staffing selection criteria, design and positioning of jobs and qualitative survey of resources.

In São Paulo, this high level of automation does not exist yet. We will find some automation processes just in some subsystems, such as the Integratet Monitoring System (Sistema Integrado de Monitoramento – SIM).

The experience of SPTrans in the night lines, which used the methodology of Operação Controlada, has proven feasible through the results of the pilot project. Its efficiency and effectiveness in managing urban transport service by bus in the city of São Paulo induce SPTrans to implement a comprehensive system providing a network of night lines operated with this model (FREDERICK; PEREIRA, 2015).

Operação Controlada will have a key role São Paulo's transportation, not only in night lines, but also throughout a new restructuring of the city's transportation network, which is expected to gradually take place by mid 2016. The next steps, Weekend Network, between rush and rush, both based on the Operação Controlada's methodology.

The positive experience achieved in night lines, however, will only be repeated if the established procedures and standards are followed.

For these reasons, we consider crucial for the shuttle service that the control stay with the government, not only for the control of public spending but also to improve the mobility in the city.

References:

[1] AGUERO, R. A. A construção do discurso sobre o trabalho infantil: mídia, imagens e poder. 2015. Dissertação (Mestrado) - Programa de Pós-Graduação em Letras, área de concentração Estudos Linguísticos, da Universidade Federal do Mato Grosso do Sul, 2008. Disponível em: http://www.ibamendes.com/2011/02/foucault-e-deleuze-do-poder-disciplinar.html Acesso em: 14/10/2015

[2] ARMSTRONG-WRIGHT, A. Urban Transit Systems: guidelines for examining options. WBTP n. 52. Washington DC: The Word Bank, 1986

[3] BRASILEIRO, A. et al. Viação ilimitada. São Paulo: Cultura, 1999

[4] CHIAVENATO, I. Introdução à teoria geral da administração. 6. ed. Rio de Janeiro: Campus, 2000.

[5] CRUZ, M. V. G. Produção do serviço de transporte público urbano por ônibus: aspectos da organização do trabalho. Revista de Administração Contemporânea, v. 2, n. 3, p. 45–65, 1998.

[6] OLIVEIRA NETO, F. M. Priorização do transporte coletivo por ônibus tráfego. [s.l.] 2004.
[7] CUNNINGHAM, G. M. Management control and accounting systems under competitive strategy. Accounting, Auditing & Accountability Journal, v.5, n.2, p. 85-102, 1992.
[8] ELAINA, J. Henri Fayol - pai da Teoria clássica da administração Disponível em: http://www.portal-gestao.com/item/6886-henri-fayol-pai-da-teoria cl%C3%A1ssica-da-administra%C3%A7%C3%A3o.html Acesso em: dez. 2014.
[9] FAYOL, H. Administração industrial e geral. São Paulo: Atlas, 1981.
[10] FOUCAULT, M. Vigiar e punir: nascimento da prisão. Petrópolis: Vozes, 2014.
[11] FREDERICO, C. S.; PEREIRA, A. L. S. Operação Controlada de linhas noturnas: estudo de caso na SPTRANS. Trabalho conclusão curso PTR5917. its – Sistemas de Transporte Inteligente – (versão preliminar de artigo a ser apresentado). Escola Politécnica da Universidade de São Paulo – USP – São Paulo – 2015.
[12] GUALAZZI, E. L.B. Regime jurídico dos tribunais de contas. São Paulo: Revista dos Tribunais, 1992.
[13] IBGE, disponível em http://www.ibge.gov.br/home/estatistica/populacao/estimativa2014/estimativa_dou.shtm acesso em dezembro de 2014.
[14] JANNUZZI, P. et al., Estruturação de sistemas de monitoramento e especificação de pesquisas de avaliação, os problemas dos programas públicos no Brasil. In: ENAP. Avaliação de Programas Sociais. Brasília, Enap – EIAPP, 2009 p.124.
[15] LUNKES, R. J. Controle de Gestão – estratégico, tático, operacional, interno e de risco. São Paulo: Atlas, 2010.
[16] MORAES, A. C.; FACCHINI, E.; BOVO, C. R. M. Planejamento e transporte a mobilidade urbana na encruzilhada : debate inadiável , soluções urgentes. Revista dos Transportes Públicos - ANTP, v. 3o quadrim, p. 8, 2014.
[17] MOSIMANN, C. P.; FISCH, S. Controladoria. 2. ed. São Paulo: Atlas, 1999.
[18] OLIVEIRA, R.A. A linha do amanhã. Disponível em http://www.softword.com.br/gestao_1.htm– acesso em março de 2015.
[19] SPTRANS. RELATÓRIO da Diretoria de Gestão. SPTrans – sistemas informatizados para a gestão do transporte coletivo do município de São Paulo – MAIO/2009.
[20] SPTRANS. RELATÓRIO de reclamações. Diretoria de Operação da SPTrans, 2014.
[21] SPTRANS. São Paulo Transporte S.A. Disponível em: http://www.sptrans.com.br/a_sptrans/ Acesso em: 08/10/2015.