

Contract Management and Monitoring: An Application to Public Transport Concessions

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Abstract

This paper aims to study the management and monitoring of public transport contracts under the new Legal Regime of Public Passenger Transport Service, approved by the Law 52/2015. This new system wishes to improve the quality of public transport service and the efficient management of those services, and assure that this process is transparent. It was required to study the means to elaborate a transport contract, and all the associated requirements, such as incentives and penalties in the contract and several ways of monitoring the bus contract.

To analyze the existing methods for monitoring and managing of the bus contracts, three international case studies and five case studies from Portugal were selected. It was observed that the Portuguese contracts were very penalizing for the transport operators, opposing to the international contracts, that awarded incentives to the operators that delivered good operational results.

Based on these results, a prospective proposal for an electronic platform to help in the contract management, was introduced. This platform operates under three aspects of contract management, the management of change, the administrative management and the operational management. This will help the operator and the authority to manage the contract in a simplified way.

Keywords

Management, Monitoring, Contracts, Public Transportation Concessions

1. Introduction

Public transport services are an essential service for the subsistence and development of the society, both in rural and urban contexts. They help in the development of the economy by transporting the population from their residences to their workplaces, schools and other activities.

In Portugal, the transport regulation exists since 1948, with the elaboration of the Regulation for Automobile Transport (RTA – *Regulamento de Transportes Automóveis*). It was continually developed and altered to adapt to the necessities of public transport. In 2007, a new directive from the European Union was introduced, that intended to give relevance to service quality in public transport and also, to increase the competition in the competition stages of the contract. This new directive was translated to the Portuguese Law no. 52/2015, demanding a significant alteration in the contracting methods in Portugal, from the elaboration of the contracts to the managing and monitoring phases.

This new law predicted the necessity for changes in the public and private ways of contracting, for both the authority and the operator. Before its introduction, public and private entities operated under a poorly regulate regime, allowing for transport concessions to be in operation for several years, having little or no control from the authority. The lack of control originated, in several cases, the decrease in service quality for the passengers, with no incentives for the improvement of the service.

Therefore, it is important, by implementing this new regime, to adapt and predict the changes it demands, allowing for the public transport system to reach its objectives, and to guarantee the development of mechanisms to assure the demanded service quality of the public transport system.

2. Contracting in Public Transport Services

A lot of entities are involved in the contract design and management stages, according to the type of contract to be elaborated. The entities relate between each other in a sequential way. Each entity exercises a type of control over the following. The main entities studied in this paper will be the authority and the operator.

There are a two of organizational ways to develop a transport service. The first, created by a public transport authority (e.g. a county, a municipal community, etc.), and awarded to an operator, by means of public contracting. The latter, by the initiative of autonomous processes of the market (van de Velde, 2004).

Establishing the organizational forms and the intervening entities, it is important to explain the planning levels in which they work, and what happens at each level. Van de Velde, in 2004, adopted the planning pyramid, to the planning of a public transport system. In the strategic level, the general objectives and service characteristics are established, such as market quotes and expected profits, general description of services, population target, etc. In the tactical level, it is important to translate the general objectives in transportation parameters, such as routes, timetables, vehicles and the ticketing system. The last level (operational) intends to transform the tactical requirements in day-to-day objectives, such as allocation of vehicles, drivers and infrastructure, to assure the objectives established in the previous levels.

Having established the planning methods for a public transport contract, it is important to understand and analyze the contract elaboration stages and its management processes. There are three main stages in this process: identification of the contract objectives; the designing of the contract; and, finally, the contract management and monitoring stage (van de Velde, Beck, Elburg, & Schüren, 2008). They can be seen in Table 1.

Table 1 – Stages of Contract Design and Monitoring

Stage	Responsible Entities	What happens in this stage?
Contract Objectives	Authority	<ul style="list-style-type: none"> The objective is to introduce a proposal for a public service transport, by means of a contract; The scope and objectives of the contract are defined (study of the transport network, frequency, routes, etc.); Service quality requirements; Definition of public service obligations, by the authority, to ensure the passengers public service in which, an operator, if it were to consider its own commercial interests, would not assume without a reward (RCE 1370/2007, 2007).
Contract Design	Authority and Operator	<ul style="list-style-type: none"> Define the contract flexibility, predicting changes in external factors, political objectives and passenger numbers. This occurs to ensure none of the intervening parties are affected by the changes (van de Velde et al., 2008); Establish the contract duration and its extension possibility. Bigger the duration, greater the flexibility; Regime for incentives and penalties; Definition of the model of risk sharing; Writing of the contract.
Contract Management And Monitoring	Authority and Operator	<ul style="list-style-type: none"> Regards the fulfilment of the obligations from both parties; Multi-dimensional area, managing financial, technical and legal aspects; Responsible for materializing the aspects defined in the previous stages of the contract; This stage should be planned from the beginning of the contract objective stages, ensuring that it isn't reduced to its basic activities of reporting and lack of quality complaints; Three main domains, relational, administrative and operational management (Cruz & Marques, 2013).

		<ul style="list-style-type: none"> • Relationship management is responsible for managing the interaction of both parties, assuring, the structure of the relationship and the interests of the intervening entities; • Administrative management acts in the administrative process of the contract, being responsible for the financial conditions, documentation, invoices and the application of incentives and penalties; • Operational management is responsible for the performance of the project, benchmarking the operational results of the operator, using key performance indicators. These were applied to the bus public transport industry by Randall, Condry, & Trompet (2007). It is also responsible for managing the risks associated with the project and the complications that may arise from the contract. Its objective is to ensure continuous improvement mechanisms in the contract, creating and maintaining value in the project.
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As it was mentioned in the previous table, it is important to establish certain mechanisms that reward or penalize the operator's productivity during the contract. These are called mechanisms of incentives and penalties, and are used to stimulate the operator to deliver a service with good performance results.

The penalties are applied according to the defaults and omissions of the operator. These can be related by failing to deliver specific services, failure to achieve certain established productivity parameters, failure to obtain the expected number of passengers, etc. If a failure in the contract is very damaging to the service and to the passengers, the authority should predict termination clauses in the contract (Buchanan, 2003).

In Portugal, it isn't very common the existence of incentives in the contract, even though this method is demonstrating good operational results in its application, as it is seen in the Transports for London contracts (Cunnington, 2015).

The incentives appear as a way to allow a gain, for both the authority, and the operator. This gain occurs by improving the service quality, and rewarding that improvement with monetary incentives to the operator.

Egger & Auerbach (2007), defined a set of guidelines to consider, when creating the incentives in the contract: Usage of incentives that only depend on the operator's performance; Assurance of the credibility from the incentives and penalties; Establishment of a direct relation between the payments of the incentives and the costs for obtaining those payments; Creation of a win-win relationship between the incentives and penalties established in the contract.

Regarding the existing types of contracts in public transport service, van de Velde (2004), explained the main differences between gross and net cost contracts.

In gross cost contracts, the authority has the commercial risk and transfers all the responsibility of the service management and its infrastructures to the operator. The operator has the responsibility of managing the service, being responsible for the production risk, for an agreed price. The resulting service profit is awarded to the authority. This type of contract is usually paid annually or by establishing a certain price for € per vehicle.km or seat per vehicle.km.

The authority, in the net cost contracts, transfers the responsibility of managing the service and its infrastructures to the operator. The operator, being responsible for both the commercial, and the production risk, has the right to every resulting profit from the service operation, since the authority doesn't pay for the demanded services (Egger & Auerbach, 2007).

To develop and understand the process of monitoring contracts, this paper studied a number of articles that suggested different methodologies for this task. In doing so, a set of indicators was collected, explaining many of the existing forms of monitoring a bus contract.

Regarding the analysis and study of international and national contracts, it will be presented, in this paper, a proposal of 20 specific indicators for contract monitoring and management, adapted to the Portuguese context.

Certain studied indicators can be read in an automatic manner, using specific technological means. This allows the contract monitoring to be made with less clutter for, both the authority and the operator.

The studied systems are named Automatic Vehicle Location (AVL), Automatic Passenger Counter (APC), and ticketing systems. They are capable of gathering a large quantity of operational, spatial and temporal data. If gathered and analyzed in a correct manner, they allow a substantial improvement in the transport services performance, namely in the service planning, in the timetables and in vehicle service quality monitoring (Hemily, Furth, Muller, & Strathman, 2006).

Integrating the AVL and APC systems, it is possible to obtain data on transport services regarding the following aspects (adapted from Hemily et. al, 2006):

- Specific objectives, regarding complaints, incidents and disputes;
- Analysis of the timetables and service times;
- Adherence to the established schedules, measuring delays, waiting times and connections between lines;
- Route analysis;
- Analysis of the demand in certain route, defining the effective in route patronage, the occupancy rate and the route's special usage;
- Mapping;
- Other operations, such as the analysis of the acceleration and softness during the journey and the operator's performance.

3. Contract analysis and results

In this chapter, eight public transport contracts were analyzed, from international and Portuguese authorities. The objective was to collect the main information from those contracts, regarding contract elaboration and monitoring. The results will be presented in terms of the monitoring methods and the existence and utility of the KPIs to evaluate the operator's performance. The remuneration methods and the existing incentives and penalties were also analyzed in the contracts.

By analyzing the International and Portuguese contracts, a broad number of indicators were collected and organized by operational and quality management. This allowed to obtain the differences between the International and Portuguese contracts, regarding the use of operational and quality management, answering the initial thesis that Portuguese contracts lacked the equilibrium between operational and quality indicators, having few of the latter listed in their contracts. Table 2 lists the collected indicators, giving the reader a perspective on the usage of contract monitoring indicators.

The analyzed international contracts were from London, Melbourne and Australia. They were selected because it is important to understand the relation between the use of incentives, the monitoring methods and the obtained results. The Portuguese contracts were from *Vila Nova de Famalicão*, *Marinha Grande*, *Vila Real*, *Aveiro* and Lisbon. They were selected to analyze the evolution of Portuguese contracting methods, from 2010 to 2016.

The indicators were aggregated according to their main measuring purpose, meaning that their monitoring method may vary between contracts. It allows to understand what indicators are actually measured and not what is measured specifically, in each contract. As can be verified in the following table, the international contracts give a greater relevance to the balance between operational and quality indicators. It demonstrates the evolution according to European standards. Portuguese contracts, on the contrary, indicate a bigger focus on operational management, such as operated mileage, occupancy rate and financial aspects as revenues and expenditures.

Table 2 – Indicators collected in the case studies

Indicator		Type of Indicator	International cases			National cases				
			Lnd	Mlb	Est	VNF	MG	VR	Av	Lsb
Mileage operated		Operational	✓	✗	✓	✗	✗	✓	✓	✓
Occupancy rate		Operational	✗	✗	✗	✓	✗	✓	✓	✗
Demand/Ridership		Operational	✗	✗	✗	✗	✓	✗	✓	✓
Reliability	Frequency	Operational	✓	✓	✗	✓	✓	✗	✗	✓
	Punctuality	Operational	✓	✓	✓	✓	✗	✗	✓	✓
Operation hours		Operational	✗	✓	✗	✗	✗	✗	✗	✓
Travel times		Operational	✗	✓	✗	✗	✗	✗	✗	✗
Quality and driver monitoring		Quality	✓	✗	✓	✗	✗	✗	✗	✓
Cleanliness of vehicles		Quality	✗	✗	✓	✗	✗	✗	✗	✓
Driver quality monitoring		Quality	✓	✓	✗	✓	✗	✗	✗	✗
Fleet quality monitoring		Quality	✓	✗	✗	✓	✗	✗	✗	✓
Client satisfaction		Quality	✓	✓	✓	✓	✗	✗	✓	✓
Customer service		Quality	✗	✗	✗	✗	✗	✗	✗	✓
Claims		Quality	✗	✗	✗	✗	✗	✗	✗	✓
Average response time		Operational	✗	✗	✗	✗	✗	✗	✗	✓
System availability		Operational	✗	✗	✗	✗	✗	✗	✗	✓
Malfunctions in work period		Operational	✗	✗	✗	✗	✗	✗	✗	✓
Staff characteristics		Quality	✗	✓	✓	✓	✗	✗	✗	✓
Stop conditions		Quality	✗	✓	✓	✗	✗	✗	✗	✗
Information		Quality	✗	✓	✓	✓	✗	✗	✗	✓
Ticketing characteristics		Operational	✗	✓	✗	✗	✗	✗	✓	✓
Public correspondence data		Quality	✓	✗	✗	✗	✗	✗	✗	✓
Contract compliance audits		Operational	✓	✗	✗	✗	✗	✗	✗	✗
Other sanctions		Operational	✓	✗	✗	✗	✗	✗	✗	✗
Security		Operational	✓	✗	✗	✓	✗	✗	✗	✗
Staff and passenger security		Operational	✓	✓	✗	✗	✗	✗	✗	✗
Number of routes		Operational	✗	✗	✗	✗	✗	✓	✗	✓
Number carried of services		Operational	✗	✗	✗	✗	✗	✓	✓	✓
Revenue		Financial	✗	✗	✗	✗	✗	✓	✗	✓
Costs		Financial	✗	✗	✗	✗	✗	✓	✗	✓

Another important difference between international and Portuguese contracts is the consideration of a regime of incentives and penalties in the international cases. This demonstrated good operational results and the improvement of the user perceived quality. On the contrary, Portuguese contracts only consider the use of penalties, showing little or no improvement in transport quality. This happens because the application of penalties has the operator delivering the minimum quality and operational standards. The inexistence of an incentive regime doesn't motivate the operator to continuously improve its services.

With the application of the Law no. 52/2015 in Portugal, incentive regimes should be considered when making new public transport contracts, assuring a continuous in the service's improvement in operational and quality performance.

4. Proposal of a Management and Monitoring Model

This chapter wishes to present a model proposal regarding the management and monitoring of public service contracts, accordingly to the documentation studied in the previous chapters.

Studying the planning levels of a public transport contract and the intervening entities in each level, a list of 20 indicators was created, organizing those indicators in each planning level (strategic, tactical and operational), type of management and the possibility to automate the interpretation of the indicator. This list will allow a better understanding of what has to be measured and studied in each planning level, giving concrete information to the corresponding entity in each contractual level. This information is related to the verification of the compliance of both parties in the contract, the identification of deviations and the adjustment of the contract.

In summary, this matrix will allow the realization of links between each organizational planning levels and the current lack of connection between the same. For instance, if the strategic objective is the obtainment of certain revenues and market quotas, these are only achieved by a good tactical definition and by measuring the achievement of these objectives, in an operational level.

Table 3 presents the selection of 20 indicators, being divided by their planning levels. These were established by the literary review and from the analysis of 8 transport contracts.

Table 3 - Proposal of indicators

#	Indicator	Level	Type	Automatic Reading	Definition
1	Demand/Ridership	Strategic	Op. Manag.	✓	Number of transported passengers
2	Operational revenues	Strategic	Op. Manag.	✓	Value of service operational gains
3	Operational costs	Strategic	Op. Manag.	✓	Value of service operational costs
4	Reliability	Strategic	Op. Manag.	✓	Capacity of organizing, controlling and adjusting the services
5	Occupancy rate	Strategic	Op. Manag.	✓	Percentage of used vehicle capacity
6	Operated services	Tactical	Op. Manag.	✓	Percentage of realized/scheduled services
7	Mileage operated	Tactical	Op. Manag.	✓	Percentage of realized/scheduled kms
8	Frequency	Tactical	Op. Manag.	✓	Number of vehicles per hour or day
9	Punctuality	Tactical	Op. Manag.	✓	Number of delays in high frequency services vs. the established services
10	Information	Tactical	Qual. Manag.	✗	Information systems, by call center, in stations and during the journey

11	Environmental impact of the fleet	Tactical	Qual. Manag.	✓	Effects of the investment and usage of the fleet to the environment (polluting emissions, natural resources and sound pollution)
12	Customer service	Operational	Qual. Manag.	✗	Customer service quality
13	On-board space	Operational	Qual. Manag.	✓	Evaluation of the average space of the vehicle, measured by seats.km.
14	On-board comfort	Operational	Qual. Manag.	✗	On-board comfort perceived on-board of the vehicle
15	On-board cleanliness	Operational	Qual. Manag.	✗	Measure to evaluate the cleanliness of the vehicles
16	A/C presence	Operational	Qual. Manag.	✓	Functioning air conditioning systems present inside the vehicles
17	Station conditions	Operational	Qual. Manag.	✗	Measure to evaluate the state of conservation and comfort of the station
18	Station safety	Operational	Qual. Manag.	✗	Presence of security systems inside the station, such as cameras and security guards
19	Driver skills	Operational	Qual. Manag.	✗	Driver's level of skills, measured by the formations in which he participated and occurrences relating said driver
20	Customer satisfaction	Operational	Qual. Manag.	✗	Measure that evaluates the global satisfaction of the customer

As it can be seen, operational management categories can be easily automated by using methods of AVL, APC and ticketing systems. Quality management is usually harder to measure, having to use qualitative criteria to evaluate the indicators. It is important to predict and quantify these types of indicators with well-defined measurement parameters. These can be evaluated with user enquiries, mystery client and inspections to the operator's services.

The verification of each indicator is made at the operational level, by the concretization of the contract. However, these have to be studied in specific stages of the contract and, according to the type of contract, by different entities.

To better explain this division, Figure 1, presents the separation of indicators between the operator and the authority in a gross cost contract (the most common in Portuguese contracts). It is important to mention that this division isn't exactly the same in every contract. Many authorities have different objectives and the indicators can be divided in other types of matrixes.

	Gross Cost	Authority	Operator
Strategic		Ridership	
		Operational Revenue	
			Operational Costs
		Reliability	
		Occupancy Rate	
Tactical		Operated Services	
		Mileage Operated	
		Frequency	
		Punctuality	
		Information	
		Fleet	
Operational			Customer Service
			On-Board Space
			On-Board Comfort
			On-Board Cleanliness
			A/C Presence
			Station Conditions
			Station Safety
			Driver Skills
			Customer Satisfaction

Figure 1 - Gross cost indicators matrix

The majority of the strategic indicators are inserted in the authority column. The ridership indicator is shared between both entities since it is an important compliance factor for the contract development. Operational Revenue is on the side of the authority, since it is a gross cost contract (Authority responsible for commercial risk). Operational costs are a responsibility for the operator.

At a tactical level, every indicator is shared between the entities, due to the nature of the contract. This happens because of the risk division in the contract. Each entity has to monitor the tactical indicators due to different reasons.

Finally, at the bottom level, the indicators are, in their majority, assumed by the operator. It's in his best interest to monitor the indicators related to the service quality. Since customer satisfaction is a relevant indicator to both entities, it was considered a shared responsibility between operator and authority. This indicator can be used to award incentives or penalties to the quality parameters of the service, offered by the operator.

5. Proposal for the Architecture of the Platform

In the following chapter, it will be presented a prospective platform for monitoring transport contracts, describing the architecture of system. This will allow the evaluation of the indicators listed in Table 3 in an automated manner, facilitating the monitoring and management of the contracts and the application of the defined incentives and penalties.

With the current regulation in transports, it is imperative to computerize, automate and simplify the phases of contract management and monitoring. With this demand, the presented proposal will tackle the possibility of automatizing these contract stages.

The platform will work by collecting certain inputs, resulting from vehicle data (AVL, APC, ticketing) and human data. These will be processed by the platform, through a set of established directives, according to the contract

objectives. In the end, it will offer a series of outputs, regarding the relevant indicators to monitor and manage the contract.

The platform has the objective to integrate the three domains of contract management, relationship, administrative and operational, studied by Cruz & Marques (2013). In the relationship management, the platform will serve as a communication mean for the entities to analyze the events happening in the contract execution phase. In the administrative management, it will be used as a repository for administrative documents of the contract (periodic reports, bills, etc.) and for the application of penalties and incentives. Operational management will be used to coordinate the previous domains, through continuous analysis of the operator’s performance.

Considering every domain, Figure 2, presents the basic structure of the functioning platform.

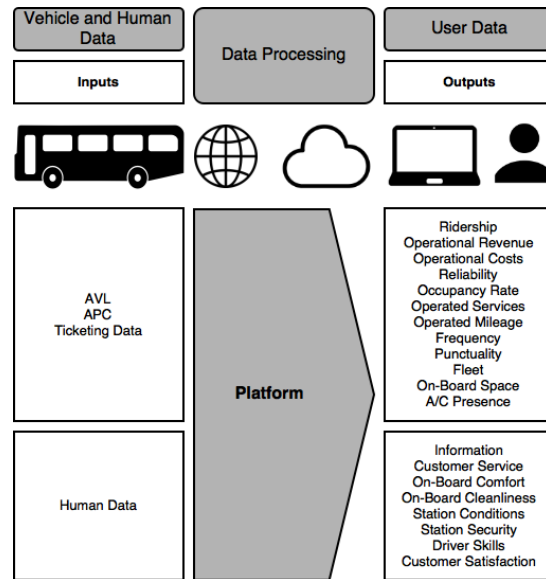


Figure 2 - Basic structure of the prospective platform

The platform is based on the collection of data, by the automatic methods studied in this paper, in the vehicle inputs. These are the estimation of passengers using the service, routes and timetables, ticketing information and human data, regarding quality indicators that are impossible to measure by automatic means.

The collected inputs are then sent to the platform, using the internet. Through a set of formulas and parameters, they are transformed in outputs and stored in the cloud for consultation.

The outputs are the indicators listed in the Table 3, and they represent a primary level of indicators. The platform has the possibility to introduce specific data of certain indicators, creating a secondary level. These are related to data regarding specific parameters, such as ridership per week, per line, or operational revenue per semester, per line, etc. This will allow both entities to analyze the contract in a microscopic and macroscopic way, making sure that every indicator is considered in the public transport contract monitoring.

6. Conclusions

This paper allowed the identification of a series of good practices in contractual management and monitoring, being useful for a future application in contracting of Portuguese public service transport. Through the literary review and the analysis of seven case studies, it was possible to collect a set of three main points in contract management and monitoring: Contract performance indicators; Application of incentives and penalties; Management of contractual changes and the relationship of the intervening authorities.

It was possible to study a series of indicators, understanding the dimension of contract management and monitoring, with several ways of measuring the operator's performance. It was important to study the simplification of these indicators, having presented a set of 20 primary indicators for contract monitoring (Table 3). Another method to simplify the reading of this list, organizing them in strategic, tactical and operational levels. This division was made with the objective of helping both entities to monitor and consult each indicator in its organizational level.

Another important fact is the relevance of contracting with performance incentives in Portugal. By analyzing international contracts, it was concluded that the usage of incentives had a great impact in the improvement of the contract's performance. Penalizing the lack of operational results will motivate the operator to deliver the bare minimum, contradicting the necessity of constant improvement in the contracts.

This proposal also predicts the reduction of operational costs in contract management. By automating a big part of the monitoring processes, a this contract phase will be processed in a shorter time period. This will allow for both the operator, and the authority to save on man hours in the contract. For example, the elaboration of a periodic report of service costs approximately 160 man-hours for the operator. The authority has a cost of 120 man-hours to analyze and evaluate that report. With the automation of the process, the platform will save approximately 380 man-hours for both entities.

In conclusion, this theme, although underexplored in Portugal, is very important and urgent in the current viewpoint of transportation. The regulatory change demands the preparation of public and private entities for the changes predicted in the law, regarding legislation and technical contents. This paper aims to ease the transition between an unregulated and underperforming regime to a constantly improving contract execution, monitoring and managing.

By doing so, it is important to study the contractual management, exploring mechanisms of automating the same, and to try to develop the presented proposal of the platform for contract management. Ultimately, it would be interesting to do an economic viability study of the implementation of the platform. To study the costs of elaborating a transport contract, the corresponding monitoring costs, and the costs associated to the development of the platform.

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