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Stakeholder Value Network: Modeling key relationships for advancing towards high quality bus transit systems

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ABSTRACT

Most urban transportation projects are complex as they involve different areas of knowledge and must accommodate conflicting interests of many stakeholders. Although good practices in public transportation do exist, many cities in Brazil and around the world are not able to maintain these improvements due to strong direct and indirect pressures from key stakeholders. The lack of trust among stakeholders has been stronger than the trust between them. Understanding the relationships between stakeholders and evaluating the critical paths are key to facilitating the implementation of improvements. This paper develops a qualitative and quantitative model that represents the stakeholders' network involved in planning, operating and monitoring public bus transportation, and identifies key stakeholders and critical paths for decision-making. To demonstrate the application of the model, we performed a case study in Porto Alegre. We identified 13 key stakeholders directly and indirectly involved in the process. Through the Stakeholder Value Network methodology, it was possible to qualify and quantify 59 value flows between stakeholders that can influence the implementation of improvements in the public transportation system. The results provide useful information to facilitate improvements and in the services provided to the population.

1. Introduction

Fifty years ago, the main challenges of large infrastructure projects were technical or scientific; nowadays, the biggest barriers faced by these projects are usually social and/or political (Mcadam et al., 2010). With regard to public transportation, the technical literature presents a large number of manuals, guides, books and studies describing how to carry out projects and the steps for their implementation and operation. Since there is a good amount of information about providing high quality public transportation service, we explore another perspective in this field: the relationships amongst stakeholders.

Public transportation is a subject of debate in most countries, in terms of both federal and local policies. Many developed countries have already achieved relative success in implementing public transportation networks composed of different modes, and the current discussions are about how to financially support the system. Meanwhile, in developing countries, one of the main challenges is to create public transportation networks, both in terms of infrastructure and operation (IPEA, 2016). In these cases, the challenge is presented on several levels: technical, political, and financial, among others. Several public transportation projects failed in their implementation by disregarding the stakeholders' interest and power (Santos, 2008).

Recent experience in Brazil has attracted attention to indirect stakeholders' interference in public transportation projects, such as Account Courts and Public Ministries. Political stakeholders, such as city councilors, still have limited influence on the improvement of public transportation. Recently, civil society groups have been imposing some pressure for improvements in the value for money of public transportation services. All these groups have interfered at different levels in public transportation projects. Conflicts among stakeholder interests tend to lead to inactivity in infrastructure improvement and fleet renewal to cleaner and more efficient vehicles, and competitive tenders slowed by lack of alignment among stakeholders, for example.

Recognizing key stakeholders and their relationships can facilitate the work of managers and optimize efforts to engage stakeholders in order to implement improvements in public transportation. This paper aims to present a qualitative and quantitative model representing the

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stakeholder network involved in planning, operating, and monitoring public bus transportation, and determine the most important relationships for the network and the critical paths for implementing improvements in public bus transportation as well. We propose the use of a modeling technique called Stakeholder Value Network in order to advance the understanding about the relationships between actors, thus facilitating the accomplishment of improvements in public transportation.

This paper is divided into five sections. Section 1 presents the foundations for the development of the study. Section 2 presents a literature review on stakeholder analysis, public bus transportation in Brazil and Porto Alegre, and the Stakeholder Value Network methodology. Section 3 introduces the building of a stakeholder network through qualitative steps (preparation of stakeholder maps) and quantitative steps (weighing relationships among them). In Section 4 we analyze the components of the stakeholders' network. To finalize the methodological development, we present the conclusions from our study in Section 5.

2. Literature review

The literature review presents the theoretical references that served as a basis for the development of this study. Considering the theme and approach chosen, we listed three major themes to include in this review: stakeholder analysis; regulation of public bus transportation and characterization of public transportation in Brazil and, especially, in Porto Alegre; and the Stakeholder Value Network methodology.

2.1. Stakeholder analysis

Different definitions have been given to the term “stakeholders”: groups and components that have a legitimate claim on the company; participants in corporate affairs (Ackoff, 1974); those who will be directly affected by the decisions (Friend & Hickling, 1987), among others. However, the most consolidated definition, and the one adopted in this paper, is that given by Freeman (1984): “any group or individual who can affect or is affected by the achievement of an organization's purpose”. A characteristic of the stakeholders involved in a situation, project, or organization is dynamism. Over time, their interests may change depending on the set of actors involved, since new interested parties may enter while others may leave, depending on the boundary conditions of the environment studied (Elias & Cavana, 2000).

Models for stakeholders analysis have evolved over time. Initially, Freeman (1984) proposed a mapping technique of the interested parties considering the central organization and the other stakeholders with whom the organization interacts directly. The map incorporates a set of several stakeholders and uses arrows to indicate the direction of the interactions between the organization and each interested party. These interactions are all direct transactions involving the stakeholders.

Freeman (1984) also introduces the idea of indirect interactions and stakeholder networks. He presents examples of simple networks containing up to five actors. He recognizes that "(…) little is known in the way of formulating strategies for utilizing such networks in a positive and proactive fashion. Little is known about what range of alternatives is open to managers who want to utilize such an indirect approach to dealing with stakeholders”. This is one of the motivations for developing the methodology of Stakeholder Value Network described in Section 2.3, which serves as a basis for the construction of the model presented in this paper.

The study by Maretope (2003) shows the importance of involving stakeholders in regulatory decisions on public transportation. The involvement of stakeholders should be seen as the creation of a common understanding for the comprehension, reflection, and reliable communication between the parties, aiming to find a solution that maximizes the benefits for the majority while minimizing the losses for the few. The greater the number of conflicting interests, the more difficult it is to achieve this objective.

Different interested parties perceive differently the impacts of a change in the transportation system, since each of them is affected in different ways by the decisions made. In general, stakeholders have greater concerns when changes involve increase in market competition than when they are related to institutional issues. Stakeholders may impose barriers to the resulting changes in the regulatory model or processes when they face some type of restriction.

Serious problems can be observed when changing regulations in the public transportation service if there is no consensus or at least a certain degree of acceptability among the parties concerned (Maretope, 2003). An analysis of the relationships between stakeholders and the construction of a consensus among them can help to achieve mutual understanding and coordination between the interested parties.

2.2. Stakeholder Value Network

In order to properly evaluate the indirect relationships between stakeholders of a particular network, Cameron (2007) developed, within the Systems Engineering center of the Massachusetts Institute of Technology – MIT (USA), the Stakeholder Value Network (SVN). It is an appropriate methodology to study, both qualitatively and quantitatively, the direct and indirect interactions between the parties involved in an organization or project. Since its inception, this methodology and its applicability have been studied and further developed by other researchers, such as Sutherland (2009) and Feng (2013), who modelled the stakeholder network of the NASA space observation program and the feasibility of the expansion of large companies' plants, respectively.

In SVN, several types of relationships (both social and economic) between stakeholders are evaluated as value flows. Next, the strategic implications of this flow across the stakeholder network are studied, so that all the relationships – both direct and indirect – may be captured at the same time in a unified structure. This study explores the potential qualitative plus quantitative analysis has to generate important information on public transportation management.

Before presenting the methodological steps of SVN, it is necessary to define some terms. SVN consists in a multi-relational network formed by a focal organization, the interested parties of the focal organization, and the relationships among them. The focal organization can be a company, a project within a company, a government agency, a non-governmental organization, or any other type of organization; value flows are the processes through which the specific needs of the focal organization and/or interested parties are satisfied (Cameron, 2007).

The methodological procedure proposed by SVN has four basic steps:

a) Mapping: defining the central point of the analysis (organization/project) and its stakeholders. Their roles, objectives, and specific needs are defined through surveys. Based on this information, a qualitative model of the SVN can be constructed in the form of stakeholder maps by mapping the specific needs of each interested party and their value flows;
b) Quantification: once the stakeholder maps are obtained, the next step is to determine the weight of each value flow based on the utility perceived by the stakeholders benefitted and define the propagation rule of the value flows in the stakeholder network;
c) Modeling: based on the quantified value flows and the value propagation rule, a quantitative model of the SVN can be constructed, establishing all the paths starting or ending in the organization/project;
d) Analysis: once the quantitative model has established all the value flows for the organization/project, the last step is to build the network statistics in order to study the strategic implications of the SVN for this organization/project.

Furthermore, it is necessary to reinforce that the SVN methodology,

like other methodologies, considers the relationships between stakeholders as a picture of the current environment. Changes in the baseline scenario suggest that a new evaluation of the network should be made.

2.3. Public bus transportation

2.3.1. Public bus transportation in Brazil

Unlike the artisanal operators present in developing cities and the monopolies of the developed countries, Brazil shows consolidated public transportation companies in a strong process of growth and concentration of capital (Orrico and Santos, 1996). For decades, groups of increasingly organized private operators have been expanding their political influence, mainly through their support to election campaigns (Orrico et al., 2007).

Over the years, public authorities and operating companies have worked in an almost joint effort to offer public transportation services. However this partnership has a certain limit: in many cities, operational data and the fare collected still remain under the operators' control, and the contract conditions shift the main economic risks to the users, leading to successive increases in fare prices above inflation. Important innovations such as accessible vehicles (low-floor or elevator-equipped buses) are introduced slowly, and information for users continues to be non-existent in many cities (Gomide, 2004, p. 2004).

Public transportation in Brazil has been losing competitiveness over the last years. Considering that most of the cities do not offer direct government subsidies to the public transportation system, the fare policy is one of the factors responsible for the economic and financial sustainability of the service operation. In a large number of cities, the setting of fare levels follows political criteria, thus negatively affecting the service provided. In a scenario of decline in the number of paying passengers, measures for recomposing the economic-financial balance of the companies are often directed towards the increase of fares, which contributes to the reduction of passengers, forming a vicious cycle that results in the financial instability of the service (Gomide, 2004, p. 2004).

The population has demonstrated their dissatisfaction with the service provided and the fare charged. In addition to the huge popular protests in June 2013, the annual readjustments aimed at appropriating inflationary increases have been accompanied by public discussions, debates, and far-reaching repercussion in the press (Assad & Queiróz, 2015). This movement may indicate that the fares are close to their limit and that regulations need to seek new ways to qualify and finance the public transportation service.

2.3.2. The case of Porto Alegre

The model proposed in this paper requires a case for application. We chose Porto Alegre due to its public transportation history. Furthermore, the city has a well-defined institutional structure and recently has been trying to implement improvements in public transportation, such as the implementation of a BRT (Bus Rapid Transit) system and the first competitive tender in public transportation service (Porto Alegre, 2007, 2015).

A BRT system had been under discussion for some years. In 2007, the project was named “Portais da Cidade”. Among the objectives of the project, treated as a public-private partnership, were: (i) the reduction of the volume of buses circulating downtown, which would contribute to reducing air pollution and increasing the safety and comfort of pedestrians; (ii) the removal of bus terminals from downtown, allowing the renovation of urban spaces and revitalization of the city's central area; (iii) physical integration of the BRT with the feeding system, allowing a safe and comfortable integration; (v) fare integration of the BRT with the feeding system; and (vi) a reduction of the production costs of public bus transportation (Lindau, Senna, Strambi, & Martins, 2008; Porto Alegre, 2007).

Despite the technical efforts and the communication of the project to the population through the press, this was not implemented. With the announcement of Porto Alegre as a host city of the 2014 FIFA World Cup, a project based on new routes was included as a city action to improve mobility.

Even after the 2014 FIFA World Cup, the bus corridors are yet to be implemented (Farina, 2018). Part of the corridors have already received new concrete pavements; however, little was done in relation to stations, terminals, and system operation. Although there were federal funds to finance infrastructure, investments by local operators were still necessary to adapt the fleet and the information systems to the BRT operation. We can argue that one of the reasons for the delay in the implementation of the BRT system is the lack of institutional guarantees.

The public transportation system of Porto Alegre had never gone through a competitive tender to select its operators before. In this case, investing in a transportation system could be risky for operators, who are not sure about how long they would operate the system and obtain return on their investment (Nitzke, 2015).

After a troubled period, when much was discussed about the fare to be charged in the public transportation system of Porto Alegre and the city went through a bus workers' strike of more than fifteen days, the first competitive tender was opened in April 2014. The first two attempts were considered “void” because there were no bids from any company. In October 2015, after its third attempt, the local government successfully concluded a competitive tender for the system (Nitzke, 2015). For the next 20 years, public transportation would be operated by consortiums formed by the companies that already operated the public transportation system of Porto Alegre.

3. Methodology

This section presents the steps followed for the development of the model proposed in this paper. The Stakeholder Value Network technique is applied to the public bus transportation service of Porto Alegre in order to construct a model representing the relationships between the different actors involved in potential improvements.

3.1. Qualitative step – stakeholder network construction

3.1.1. Definition of stakeholders

One of the most important methodological decisions concerns the correct definition and characterization of the focal organization/project on which modeling and analyses will be centered. The technique allows a project to be used as the center of the analysis. Thus, we chose to consider a large hypothetical improvement, such as the implementation of new bus corridors, terminals and/or fleet renewal, as the focal organization of this model.

The first step of the study is the identification of the stakeholders involved in projects to improve the public bus transportation in Porto Alegre. The literature on the subject has very scarce references, thus we had to adopt alternative methods to identify these stakeholders. As primary data source, we collected information through interviews and data collection in the press. Due to the relevance of and the emphasis on the subject in the press and official websites, these were chosen as the initial information source for the mapping of stakeholders. Between March 26, 2013 and July 01, 2014, we collected 91 reports and notes published in local and national newspapers and official government websites, such as the City Hall and City Council. For each of these reports, we identified the stakeholders mentioned. From this mapping, it was possible to establish an initial list with more than 30 stakeholders.

As some stakeholders have similar attributions, and due to the limitations of the method used in this model, we decided to reduce the number of stakeholders involved in the modeling with the help of interviews with experts (Ribeiro & Milan, 2007, p. 22). According to the frequency with which they appeared in the reports and their participation in public transportation, the number of stakeholders considered in the modeling was reduced to 13, one of them being the hypothetical

Table 1
–The most relevant stakeholders in the improvement of the public bus transportation service in Porto Alegre.

Stakeholder	Description/objectives
Local Government	Strongly represented by the mayor: leader of the municipal executive power, main decision-maker on city public transportation
State Governor	Leader of the state executive power, main decision-maker on metropolitan public transportation
EPTC	Local agency responsible for managing and qualifying city public transportation
METROPLAN	State agency responsible for the elaboration and coordination of plans, programs and projects of regional and urban development at the state level, including metropolitan public transportation systems
Operators	Provider of public transportation services to the population
Population	Residents of the city and public transportation users
Councilmen	Representatives of the Legislative Power in the city, i. e. make and vote local laws and monitor the mayor's actions
Judiciary	Provides judicial protection to each and every one, indistinctly, as guaranteed by the Constitution and the legislation, distributing justice in a useful and timely manner
Court of Auditors	Administrative court; judges the accounts of public administrators and other people responsible for monies, assets and federal public securities
Press	Responsible for providing precise and reliable information about facts and peoples to the citizens
Bus Drivers	Workers of the public transportation system
Local Organizations	Representatives of the local population in the decision-making on the application of public funds and rules established by the executive and legislative power
Improvement in Public Transportation	Focal project, center of the analysis. Represents large potential improvements in public transportation

project of improvement in public transportation. Table 1 shows the most relevant stakeholders and a brief description of each one.

In addition to the list of stakeholders, the literature and reports we collected in the press and official websites served to survey the relationships between stakeholders. According to the demands, requests and facts reported, it was possible to identify some of these relationships. Yet, not all of them can be captured through analysis of the literature and reports collected. Again, information provided by specialists on the subject is essential – mainly those who have experience in the historic and local context (Ribeiro & Milan, 2007, p. 22).

From the initial survey and the interviews with experts, we could identify, for each stakeholder, its needs (inputs) and potential to meet the others' needs (outputs). These needs are the value flows that will later form the stakeholder network and be quantified in the analysis. We identified 59 value flows in all.

3.2. Quantitative step – quantification of the relationships between stakeholders

"Quantifying" is the second step in the SVN analysis, and its specific objective is to transform the stakeholder maps into a quantitative model by giving the value flows a score based on the utility perceived by the stakeholders and defining the propagation rule of the value flows in the network in order to calculate the score of a given value path. This quantitative model is constructed based on the information collected through questionnaires answered by individuals with high knowledge on the context of public transportation and on the group of stakeholders selected.

We invited transportation experts and people that could represent the stakeholders of the model to answer the questionnaire. Among the respondents were representatives of EPTC, the Court of Auditors, municipal and metropolitan operators, local organizations, Metroplan, the population, the press and also people without any direct relationship to the groups but with great experience in public transportation in Porto Alegre. When assigning to each stakeholder a satisfaction score for receiving the input and providing the output, each respondent should put him- or herself in the position of the stakeholder in question.

The questionnaire considers the value flows received by each stakeholder and evaluates attributes of these flows. The more attributes are included in the evaluation, the more qualified the model can be, giving the basis for more refined decisions; on the other hand, the more attributes are included, the more difficult it is for the researcher to draw up the questionnaire, as well as for the stakeholders to fully understand the questionnaire and fill in with reliable answers. Based on the experience of previous researches (Cameron, 2007; Sutherland, 2009), two or three value flow attributes are enough to accomplish the analysis of the entire network. "Intensity of a need" and "Importance of the source meeting a need" are the most frequently used, since they describe the value flow completely, on both demand and supply sides by the stakeholders. Therefore, this research uses (i) stakeholder satisfaction in receiving the input and (ii) importance of the stakeholder to provide input for the construction of the quantitative model.

Tables 2 and 3 show, respectively, the questionnaire on the stakeholders' satisfaction in receiving the input and how important it is for the stakeholder that the input is provided, according to Feng (2013).

Each answer can be translated into a numerical coefficient. This study uses the non-linear scale proposed by Feng (2013), which varies from 0.11 to 0.98. This scale allows better differentiation between value flows considered absolutely necessary and those not so important. It guarantees that significantly important needs are distinguished from the important, but not critical ones. Table 4 shows the numerical representation of the questionnaire for the satisfaction of stakeholders in receiving the input and the importance for the stakeholder of the input being provided.

We carried out 16 interviews. After the questionnaires were answered, the data were tabulated and the score of the value flow for each interview was obtained by multiplying the score of the answers of stakeholder satisfaction in receiving the input and the importance for the stakeholder of the input being provided. Considering that each attribute has a 5-point scale, 25 combinations of the two attributes are possible. Table 5 shows the score of the value flow given by the multiplication of the scores of each attribute. For example, if an attribute is classified as B in terms of stakeholder satisfaction in receiving input and 4 in relation to the importance for the stakeholder of the input being provided, the score of this value flow is 0.11. Since all the attribute scores range from 0.11 to 0.96, the multiplication of the attributes values maintains the final result between 0 and 1, which is consistent

Table 2
Questionnaire on the satisfaction of stakeholders in receiving the input.

Intensity of each stakeholder's satisfaction	
If, from the stakeholder's point of view, the need must be met, how important is each source in meeting the need?	
A	Would be pleased with the service and would not regret the non-compliance
B	Would be pleased with the service and would regret a little the non-compliance
C	Would be pleased with the service and would certainly regret the non-compliance
D	Service is important and the non-compliance would be regrettable
E	Service is absolutely essential and the non-compliance would be regrettable

Table 3
Questionnaire on how important it is for the stakeholder that the input is provided.

Importance of the source meeting this need	
If, from the stakeholder's point of view, the need must be met, how important it is that each source meets the need?	
1	Not important – I do not need this source to meet this need
2	Slightly important – It is acceptable that this source meets this need
3	Important – It is preferable that this be the source meeting this need
4	Very important – It is highly desirable that this source meets this need
5	Extremely important –The source is indispensable in meeting this need

Table 4
Numerical representation of the questionnaire for the satisfaction of the stakeholders in receiving the input and the importance for the stakeholder of the input being provided.

Stakeholder satisfaction scale in receiving the input	Stakeholder importance scale of input being provided	Numerical value
A	1	0.11
B	2	0.19
C	3	0.33
D	4	0.57
E	5	0.98

with the Utility Theory. To determine the final score of each value flow, we used the median of the values obtained in each interview. The use of the median allowed to highlight central values and to discard extreme values in the set of answers resulting from misinterpretations by the respondents.

3.2.1. Calculation of the value path

Once the final score for each value flow had been determined, we used a program developed by the author of the method to determine value paths (Feng, 2013; Sutherland, 2009). A value path is formed by value flows that start at the focal project (in this study: improvement in the public transportation), go through the stakeholder network and return to the focal project. The value path is determined by multiplying the scores of the value flows that make up the path. A simple example: the improvement of public transportation may attract passengers (increase in revenue for operators) and is scored 0.44; the operators invest in fleet and information technology to enable improvement in public transportation and are scored 0.56; the final score is given by the multiplication 0.44*0.56, which gives a value path of 0.2464. Fig. 1 shows this example.

The multiplicative rule ensures that: (i) all the scores of the value path remain within the interval [0 to 1], which is consistent with the traditional definitions of the Utility Theory; (ii) under the multiplicative rule, the longer paths tend to have the lower scores, indicating the fact that with the increase of link length it becomes increasingly difficult to engage stakeholders; (iii) the multiplicative rule simplifies the calculation of the value paths. In all, we have identified 2320 possible value paths on the modelled network.

4. Stakeholder network analysis

From the qualitative and quantitative models presented in Section 3, we determined critical paths for public transportation improvements in Porto Alegre, and the type and strength of the relationships existing between them. The present section seeks to analyze this information. When ordering the value paths from the highest to the lowest score, we observe a sharp drop in the score of the paths. While the maximum score obtained was 0.3010, the link in the 9th position already shows half of the maximum score, while the link in the 56th position shows 1/6 of the maximum score. In this study, we analyzed the 10 value paths with the highest score. These are considered critical paths for the implementation of improvements in the public transportation, for they provide greater added value. Each path brings information on stakeholders and bears direct and indirect relationships to the improvement of public transportation. Fig. 2 shows each of the 10 most critical paths for the stakeholder network.

The critical path number 1 (CP1) had the maximum score, 0.3010. According to the value path, an improvement in the public transportation offers the population quality gains in the service, the population transfers resources to the local government through taxes, and the local government makes decisions to ensure more improvements. In this first critical path, we found the indirect relationship of fundraising from taxes to the local government. This relationship may represent the importance of the availability of resources to invest in improvements in public transportation. In addition, we can analyze that the population would have more confidence that the resources paid in taxes are being well-used if they perceived a gain in the quality of the service provided. Finally, the improvement in the public transportation needs a strong decision-making by the local government.

Critical path number 2 (CP2) had a score of 0.2464 and is composed only by direct relationships to an improvement in public transportation. This link shows the attraction of passengers as a benefit of the improvement in public transportation for the system operators, while the latter offer the fleet and information technology needed to make the improvement. The attraction of passengers to the public transportation system can be translated as an increase in the revenues of the operators, which, after achieving a certain level, makes the investment in fleet and technology profitable. This critical path shows only financial relationships, which points to the importance of an economic and financial evaluation to ensure improvements in public transportation.

Critical path number 3 (CP3) had a score of 0.2383. This path shows that a gain in quality offered by an improvement in public transportation can lead to an increase in fare collection and thus encourage operators to invest in fleet and information technology. The indirect relationship of increase in fare collection can occur in at least two ways: increase in the number of passengers using the public transportation and/or increase in the fare charged, since the service has better quality. The revenue increase makes it more attractive to the operators to invest

Table 5
Value flow scores given by the multiplication of the scores of the satisfaction attributes of stakeholders in receiving input and importance for the stakeholder of the input being provided.

		Importance for the stakeholder of the input being provided				
		1 = 0.11	2 = 0.19	3 = 0.33	4 = 0.57	5 = 0.98
Stakeholders satisfaction in receiving the input	A = 0.11	0.01	0.02	0.04	0.06	0.11
	B = 0.19	0.02	0.04	0.06	0.11	0.19
	C = 0.33	0.04	0.06	0.11	0.19	0.32
	D = 0.57	0.06	0.11	0.19	0.32	0.56
	E = 0.98	0.11	0.19	0.32	0.56	0.96

Fig. 1. Example of value path.

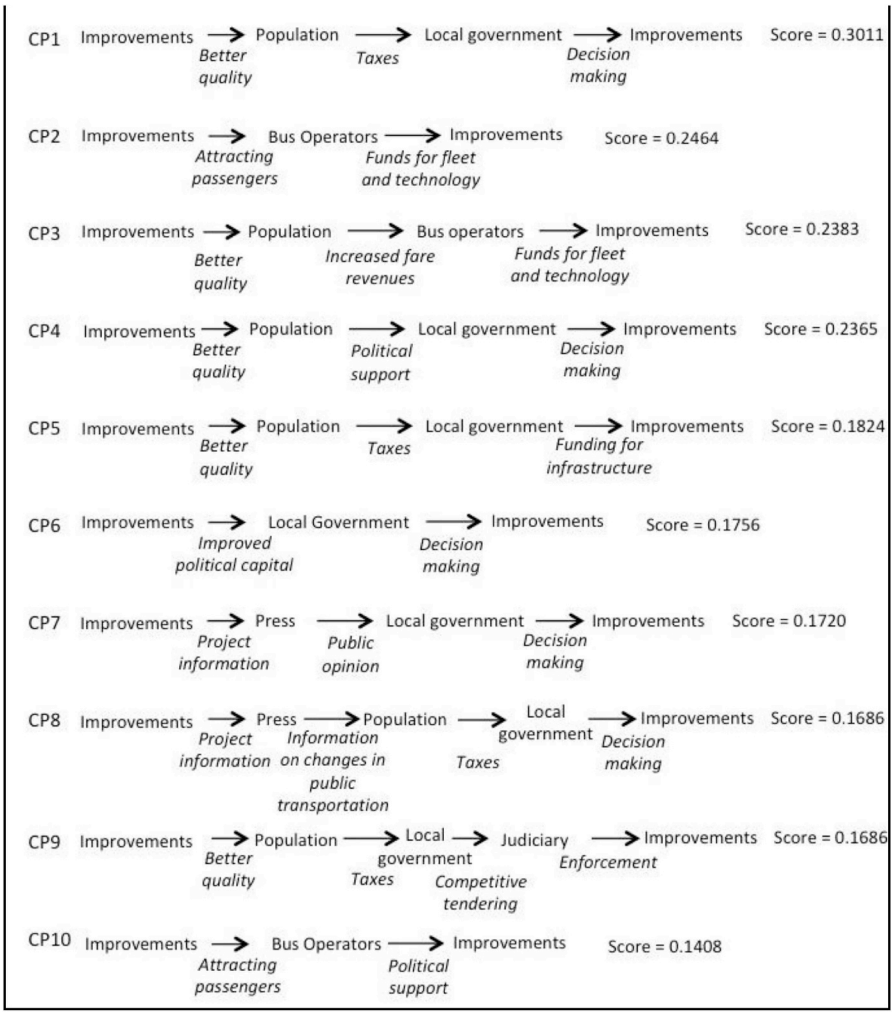

Fig. 2. The 10 most critical value paths.

in improvements.

Critical path number 4 (CP4) had a score of 0.2365 and shows a structure similar to critical path number 1. According to this path, after perceiving the quality gain offered by an improvement in public transportation, the population politically supports the local government, which feels more confident in making decisions on the improvements proposed. This critical path demonstrates the importance of clearly presenting the benefits of the improvement project to engage the population and attract it as a supporter of the project.

Critical path number 5 (CP5) received a score of 0.1824 and also shows a structure similar to critical path number 1. Despite having the same stakeholders, the difference between the paths lies in the relationship of the local government with the improvement in public transportation. When it receives more resources from taxes, the local government not only makes the decision to make an improvement, but also has the resources to invest in the necessary infrastructure.

Critical path number 6 (CP6) had a score of 0.1756. This critical path shows only direct relationships and shows how an improvement in public transportation can enhance the political capital of a mayor, increasing his or her popularity among the population. Recognizing this relationship can facilitate the decision-making by the local government to carry out an improvement in public transportation.

Critical path number 7 (CP7) received a score of 0.1720 and introduces a new stakeholder: the press. CP7 shows that the press needs information on the improvement in public transportation. The availability and quality of this information can be decisive in forming public opinion and may impact on the decision-making by the local government.

Critical path number 8 (CP8) had a score of 0.1686. This path differs from the previous ones by presenting two indirect relationships to the central point of the analysis (improvement in public transportation). By receiving information about changes in public transportation, the press passes the information to the population. Although the payment of taxes is not conditioned by the information received, knowing how taxes are used may increase the confidence of the population, and this may influence the decision-making by the local government.

Critical path number 9 (CP9) had a score of 0.1686 (same as critical path number 8). In this critical path, the population receives a quality gain through the improvement in public transportation, the local government receives from the population the resources coming from taxes, while the local government conducts the public transportation bidding – a process strongly demanded by the judiciary, which supervises the

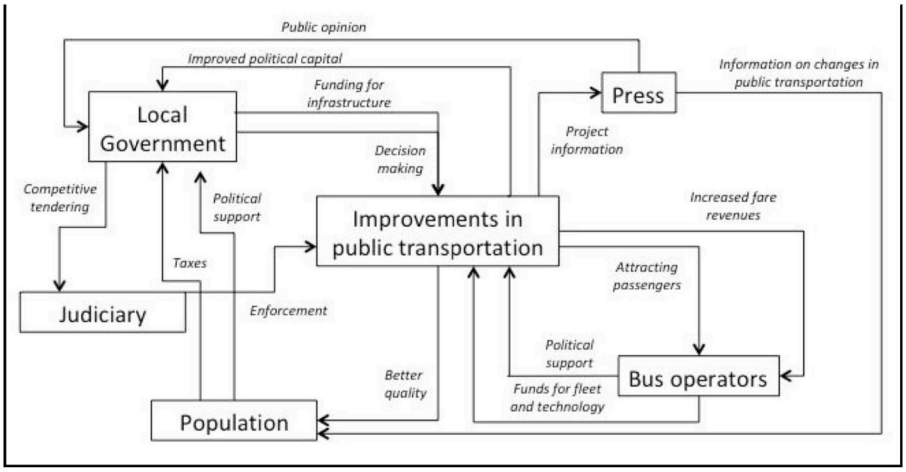

Fig. 3. Value flows that make up the 10 most critical paths for an improvement in the public transportation of Porto Alegre.

improvements in public transportation in order to ensure its compliance to both the law and the contracts in force. The emergence of competitive tendering in the main critical paths demonstrates the importance of the subject. We can interpret that the security of the institutional and legal arrangements in the public transportation system is important to guarantee political and financial investments in improvements.

Finally, the last critical path analyzed is number 10 (CP10), which received a score of 0.1408. The improvement of the public transportation shows the potential to attract passengers to the system (which can be translated into more revenues), thus facilitating political support to the project by the operators.

Despite the downward trend in the score of the value paths with an increase in the number of stakeholders, we observe that only 3 of the 10 critical paths show only direct relationships. This demonstrates the importance of evaluating the indirect relationships present in the stakeholder network too.

We observe that 5 of the 10 value paths with the highest scores end with “Decision-making” by the local government as an input for the improvement of the public transportation of Porto Alegre. This value flow received a high score from the respondents. Even after applying the median to consolidate the questionnaire answers in a single value, “decision-making” received a score of 0.96. This weight and the frequency with which it appears among the most critical paths demonstrate the importance of managers committed to making the necessary improvements in public transportation.

Both for political support and the attraction of resources from bus operators for improvements in public transportation, it is important to design good financial arrangements that guarantee an adequate return to the investment required. Continuing in the investment issue, the resources paid in taxes by the population appear in 3 of the 10 critical paths with the highest scores. Provided that the local government has good financial health, these resources could mean more investments in infrastructure. Among the respondents' answers, resources for infrastructure by the local government received the second highest score (tied with resources for fleet and information technology, and monitoring of laws and contracts by the judiciary) as an input for the improvement of the public transportation in Porto Alegre.

Among the ten critical paths with the highest scores, only six of the 13 stakeholders analyzed are mentioned: the local government, the population, operators, the press, the judiciary, in addition to the improvement in transportation, which is the center of all the value flow links. Considering the six first critical paths (in terms of score) only, local government, operators, and population are mentioned.

Indirect relationships – such as resources from taxes and fare collection, which represent financial resources to be provided to the system – appear more than once in the critical paths with the highest scores. Political support to the local government by the population and the formation of public opinion about the local government by the press also appear as important indirect relationships. Among the relationships present in the critical paths with the highest scores is the emergence of the press, which does not have a direct relationship with public transportation but, due to its close relationship with the population, has a great potential to inform and form opinions. Fig. 3 graphically represents the stakeholder network created after combining the 10 most critical paths for an improvement in the public transportation of Porto Alegre.

5. Conclusions

This paper aimed at presenting a qualitative and quantitative model representing the network of stakeholders engaged with planning, operating, and monitoring the public bus transportation, as well as determining critical paths for the implementation of improvements in the public bus transportation. By applying the Stakeholder Value Network technique and using the city of Porto Alegre as a scenario, it was possible to achieve our goal by qualitatively and quantitatively mapping the main stakeholders of public bus transportation and their mutual relationships.

By observing the results on critical paths for the implementation of improvements in public transportation, they appear to be consistent with the empirical knowledge, for they represent well the knowledge reported in the literature and the opinion of the study respondents. The results, however, treat in an unprecedented way the importance of each stakeholder and the weighing of the relationships between each and every one of them.

By presenting the local government, the operators and the population as main stakeholders, the model shows the importance of engaging the population in the discussions about public transportation. According to some of the main critical paths, one of the main forms of engagement is the transfer of information through the press and other media. At this point, the importance of a good communication strategy is highlighted to engage the population to support the improvements.

Another important point highlighted by the model is the need for legal certainty evidenced by the presence of the “competitive tendering” relationship. Legal certainty for operating companies and local government is fundamental to make larger investments either in infrastructure, fleet or technologies.

Although complex, the initial stakeholder network can be reduced to the relationships having more structural importance for improvement projects in public transportation. Simplifying the stakeholder network helps to concentrate efforts only on the more important relationships to improve public transportation.

Regarding the technique used, even if the multiplicative rule to form value path scores tends to reduce them with the increase in the number of stakeholders (and, consequently, of the relationships between them), the main critical paths showed more than one stakeholder engaged. This demonstrates the importance of evaluating indirect relationships.

Although we have achieved our main objective, we understand that the theme of relationships between actors still needs to be explored in more detail. There are several relationships between them that are not pointed out directly, which creates a barrier to understanding the existing power relations. Sometimes the lack of information and transparency was an obstacle to refining the model presented.

The results can be interpreted as a picture of the current situation of Porto Alegre and should not be replicated without proper adaptation to the case of each city. The modification of conditioning factors and the entry or exit of stakeholders in the network can change the results. Practical applications can lead to deeper analyses by concentrating and detailing the data collection around a specific improvement project.

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